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This is a monthly publication presenting brief articles concerning recent developments in European Scientific Research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications.

The articles are written primarily by members of the staff of ONRL and occasionally articles are prepared by, or in cooperation with, members of the

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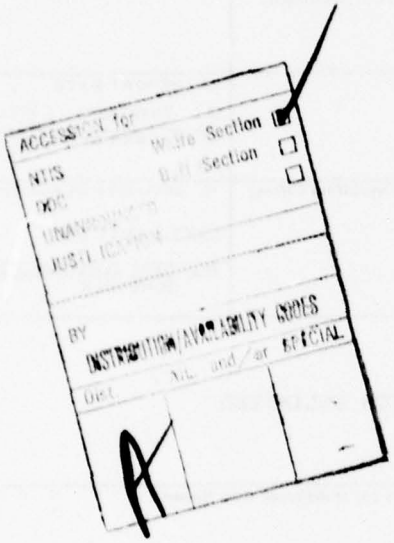
scientific staffs of the United States Air Force's European Office of Aerospace Research and Development and the United States Army Research and Standardization Group. Articles are also contributed by visiting Stateside scientists.



EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON

Aubrey W. Pryce and Victoria S. Hewitson

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BIOLOGICAL SCIENCES

DOES FLU COME FROM HALLEY'S COMET?

I had not planned to cross the Atlantic again in 1978, but a cable of invitation offering part expenses to attend the 4th Gregynog Astrophysics Workshop (7-11 August) was too much to resist. The idea of an old nuts and bolts engineer participating in a Workshop on Cosmochemistry and the Origins of Life seemed intriguing, even if I felt like an imposter. The airline did at least manage to make me feel like a criminal to qualify for the standby reduction (sign up at midnight, buy ticket at 4 but can't check baggage until 6 for a 9 am flight), and I arrived at Gregynog, the beautiful country estate of the University of Wales, after 42 hours of travelling in time to miss two reportedly excellent keynote papers, a review of the astrophysics relevant to "cosmochemistry" by Phil Solomon (State Univ. of New York at Stony Brook) and of numerous "origins of life" possibilities by Cyril Ponnamperuma (Univ. of Maryland).

The Workshop brought together people in astrophysically- and biologically-oriented disciplines to reexamine various evolutionary possibilities, and I listened to a number of carefully crafted "position" papers, most of which had obviously been presented more than once previously but which were simply fascinating to an outsider. Papers were presented on interstellar dust chemistry and experimental observations by N. Nakagawa (Tokyo), K. Nandy (Edinburgh), D.H. Morgan (Edinburgh), and A. Sakata (Tokyo). Comets, theoretical and experimental, were covered by S. Yabushita (Kyoto), and W.M. Irvine (Univ. of Massachusetts-Amherst). On the origins of life side, discussions were given by H. Noda (Tokyo), M. Paecht-Horowitz (Rehevot, Israel), A.W. Schwartz (Nijmegen, Holland), J. Ricard (Marseille), J.T. Wimpenny (Cardiff), A.G. Cairns-Smith (Glasgow), and by Ponnamperuma, who reviewed the evidence provided by the carbonaceous chondrites. I was particularly intrigued by the ideas of Cairns-Smith as to the appropriation of inorganically evolved crystalline structures ("form") by biological entities ("substance").

The dominant theme of the Conference, however, was the serious examination of the recent ideas of Profs. Sir Fred Hoyle and Chandra Wickramasinghe (University College of Wales, Cardiff) as to the extraterrestrial evolution of life. Their proposed chain of events goes something like this: Because of their effectiveness as infrared radiators, long flat polymers are the preferred minimum energy result of chemical reactions in interstellar space. The exponential nature of their growth assures their eventual dominance. As evidence for their existence, Hoyle and Wickramasinghe say that the complex infrared spectrum of interstellar dust closely matches that of cellulose, which is fairly high up the biochemical chain. The next step is the agglomeration of this "pre-biotic" material on comets, on which conditions at certain depths below the surface are thought to be favorable for the development of more complex forms of life, up to at least the level of viruses. Biologically active material, when expelled from the "long period" comets as they approach the sun as a fine dust, with viral material presumably protected from killing radiation by a "cellulose" coating, can enter the earth's atmosphere without excessive temperature rise if the grains are sufficiently small. The optical transparency and good infrared radiation efficiency of the presumed long polymers enables them to exist at a temperature much lower than the surrounding atmosphere and aids in cooling during atmospheric entry.

The next link in the chain is transmission down through the earth's upper atmosphere, and I had been invited because of a recent letter to *Nature* (268, 710) in which I had pointed out the evidence, mainly from sounding rocket measurements in the mesosphere (~40-80 km), that the density and flux of very small extraterrestrial "aerosol particles" down through the atmosphere is many orders of magnitude greater than generally supposed, and that this flux could be controlled by electric fields as well as turbulent mixing. Occasional rapid transport is possibly associated with sunspot activity, which causes the particles to become ionized and drift rapidly in the earth's global electric field circuit.

The final link is the dissemination of material in the troposphere by meteorological process, and Wickramasinghe presented compelling evidence that influenza is not ordinarily transmitted from person to person but is of airborne and probably extraterrestrial origin.

Careful surveys of the outbreak of flu in a number of schools in England and Wales last winter showed statistical patterns which, with monotonous regularity, were five or six standard deviations outside of what would be expected from person-to-person transmission and right on the norm for the airborne hypothesis (Example: Two dormitories with nearly all residents contracting flu in one and only a few in the other, whereas the average attack rate should prevail if transmission is person to person). Reported absences were incredibly well correlated with meteorological indices relating to precipitation and atmospheric turbulence, with a three day (incubation time) delay. (Don't go out in blustery weather).

An unwary biologist brought up the "host specificity" of viruses as a clinching argument against the extraterrestrial origin of influenza, calculating the probability of a flu virus developing in outer space as one in 10^{139}. Hoyle was waiting for this one, and answered, "We would know our ancestors". In the Milne Lecture at Oxford University earlier in the year he had outlined a theory of evolution as a continual biological interaction of the creatures of earth and extraterrestrial matter, in which he contended that the insertion of new genes into terrestrial organisms has occurred far too rapidly to be explained by Darwinian mechanisms. (If not a steady state cosmology, at least a steady state biology.)

Interesting consequences of this viewpoint include the important role of disease in evolution—it becomes necessary for mutation. Also, different comets would provide different genetic assortments; for example, Hoyle believes that all flu comes specifically from Halley's Comet, citing as evidence the relative immunity to just about anything that comes along (goes around?) of people old enough to have been alive during the last visit of the comet in 1910.

Most of the Hoyle-Wickramasinghe ideas are contained in a series of short papers over the last couple of years, with the astrophysical part in *Nature* (268, 610; 270, 323; 270, 701; 271, 229) and the biological principally in *The New Scientist* (76, 402; 79, 946). The latter contains evidence for the extraterrestrial origin of disease from historical sources, including Thucydides, and the extremely compelling evidence provided by the pandemic of 1918, which broke out the same day in Boston and Bombay, and affected numerous isolated locations such as Kodiak Island, where there was no chance of initiation by person-to-person transmission. The concentration on the influenza issue appears to be a means of establishing credibility in an area that is of immediate relevance to the general welfare, important in today's research climate. It is also of the nature of proving a lemma, from which the whole revolutionary evolutionary theory follows inevitably.

A sign of the times was the relatively large Japanese contingent, all of whom presented fine papers. On a pre-breakfast walk one of them told me that they realized the inability of the United States to carry on a broad and effective program of scientific research, but he voiced the opinion that they realized their responsibility to pick up the torch. He thought that if NASA abandons a Halley's Comet rendezvous, they would certainly do it. (Fine, but isn't 1986 coming up a bit soon to start now, even if you are driven?)

The concluding paper was an exhaustive discussion of the development of planetary atmospheres and consequent biological implications by Dr. P. Decker of Hannover, in which he predicted that life forms will be detected on Mars by digging to the depth of a transition from oxidizing to reducing conditions.

Getting home was much simpler. Ignoring the horror stories on TV (it was mid-August), I lined up at 6 am in Kensington and made the noon flight. So did the people who came at 9 am. I should have bought a return ticket as the decline of the dollar during the week had pushed the fare up to $132.00. (Leslie C. Hale, Ionospheric Research Laboratory, The Pennsylvania State University, PA)

ONRL REPORTS

See the back of this issue for abstracts of current reports.

FOURTH INTERNATIONAL CONGRESS OF PARASITOLOGY, WARSAW

The World Federation of Parasitologists met in Warsaw at the Palace of Cultures and Science on 19-26 August for ICOPA IV. The Congress was organized and sponsored by the Committee for Parasitology of the Polish Academy of Sciences and the Polish Parasitological Society and was under the patronage of the Chairman of the Counsel of State of the Polish Peoples Republic, Prof. Dr. Henrik Jablonski. The theme of the Congress was "World United Against Parasites." The purpose was to prevent the wastage caused by parasitic diseases and to increase the availability of animal protein to feed the multiplying human population.

The attendees included individuals interested in parasitic diseases of man and animals from most of the world's countries. The scientific program was divided into nine sections, each having a number of workshops and two plenary review sessions. The chairman and co-chairman of each workshop reviewed, submitted and organized the program accordingly. Invited experts also gave review lectures on recent advances in their field. As might be expected, the individual papers and workshops varied in quality. In any event it would be impossible to cover all the sessions in this brief article and therefore only a few will be covered in some detail.

"Parasitic infection of the gastrointestinal tract" was chaired by Prof. A.B. Chowdhury from India. He spent considerable time reviewing the recent literature on the clinical aspects of parasitic diseases of the intestinal tract. This was followed by a discussion on the variations in the preparent period during hookworm infection. The workshop on "Antibodies against parasites; characterization and action" was chaired by Prof. E.J.L. Soulsby, formerly of the Univ. of Pennsylvania but now of Oxford University. He began with a review of the action of antibodies in parasitic infections. He stressed the importance of IgE and IgA, the latter particularly in the digestive tract. The specificity of both parasitic and cytophilic antibodies was discussed. From the literature of the past few years, it is apparent that antibodies are not only helpful in preventing and combatting parasitic infections, but on some occasions they can help the parasite and assist its survival in the host. Several scientific papers were presented and discussed on the subject of antibodies and the host-parasite interaction.

The second section of this workshop consisted of discussions of passive immunity; whether serum or cellular factors can transfer protective immunity from an immunized animal to a naive, nonimmunized animal. Different responses occur when different stages of the same parasite are used and also depend upon which experimental animal is studied. Results obtained when using mice may not be reproduced in rats. A discussion was given by Prof. A. Capron of Lille, France and his wife on the passive transfer of immunity in rats to hyperimmune schistosomiasis sera. The protective effect could be abrogated following treatment on an IgE column, suggesting that IgE plays a part in this phenomenon. Soulsby then discussed the role of IgA in parasitic immunity. He suggested that the lymphoid tissue itself must be studied to obtain the lymphoid cells secreting specific immunoglobulins. An interesting paper from the Center of Disease Control in Atlanta, Georgia described an outbreak of acute *Toxoplasma gondii* infection in 37 adult patrons of an indoor horseback riding stable. These individuals apparently were infected by the oocyst form of the parasite which was passed in the stool of the numerous cats who were in and about the stable. One young woman had an abortion, and the parasite was isolated from her product of conception.

The proceedings of ICOPA (V) (eight volumes, in English) may be obtained from Prof. W. Slusarski, Department of Parasitology, Univ. of Warsaw, 00-927 Warsaw, Poland.

During ICOPA IV at the request of the International Atomic Energy Agency, their consultants met on 23 August to consider and organize a program in human parasitic diseases. The consultants agreed on the following recommendations, which have been presented to the IEA for approval and implementation: (1) Assist in development of irradiation-attenuated vaccines to human parasitic diseases; (2) assist in development of serological tests utilizing radioisotopes to diagnose parasitic diseases; (3) assist in epidemiological studies of endemic areas for parasitic diseases;

(4) encourage training and teaching of scientists and technicians from less developed countries in the use of radioisotopes to diagnose and control human parasitic diseases; (5) encourage studies on the parasitic diseases utilizing radioisotopic techniques, and (6) encourage collaborative research between scientists and institutions in developing countries with scientists and institutions in developed countries.

Further information about this program can be obtained from Dr. J.B. Castelino, International Atomic Energy Agency, Karntering 11, P.O. Box 590, A-1011, Vienna, Austria.

(CAPT G.T. Strickland, MC, USN, Uniformed Services University of Health Sciences, Bethesda, MD)

ENGINEERING

OPTICAL COMPUTING 1978

The International Optical Computing Conference (IOCC-78) was held this year at City University in London. This was the fifth such conference and was sponsored by the IEEE Computer Society in cooperation with the Society of Photo-Optical Instrumentation Engineers (SPIE), the US Office of Naval Research (ONR), and the Naval Underwater Systems Center (NUSC). Two previous conferences on the same subject were held in 1976 on Capri, Italy (supported by the same agencies) and in 1977 at Visegrad, Hungary [supported by the Computer and Automation Institute of the Hungarian Academy of Sciences. (See *ESN* 32-2:74 and ONRL C-4-78)].

The subject of this Conference was restricted to optical signal processing, as image processing was to be the subject of an International Commission on Optics (ICO) Meeting in Madrid the following week. Even with this restriction, however, there was still a fairly large diversity evident in the papers. The attendance was not large—69 registrants from the US, UK, France, Germany, and Japan participated. The proceedings of the Conference are to be published by the IEEE in a few months.

The diverse nature of the papers brought out the fact that the term "optical computing" means something different to different groups of experimenters and that it may be several years before a unified definition is accepted.

The Conference was divided into six sessions: Spatial light modulators, acousto-optic technology, optical processing for radar and sonar, novel optical processors, noncoherent optical processing, and optical mathematical operations. A significant number of papers discussed devices, and perhaps this is indicative of progress in this field.

The first session on modulators covered a subject that the attendees generally agreed represents the greatest technical limitation to the practical use of optical processing in real time, such as for signal processing. Although some very interesting new aspects of previously reported materials were discussed, there was no real breakthrough in evidence, and it appears that development of better real-time modulators will continue to be slow.

Acousto-optical techniques are being used by several laboratories to develop methods of direct modulation of light by sound without going through an intermediate electrical step. I. Fromm (Siemens AG, Forschungslaboratorium, Munich, FRG) described a few techniques involving reflection from thin membranes. One of these is a very simple device and could be called a fiber-optic microphone. The scheme is shown in the figure.

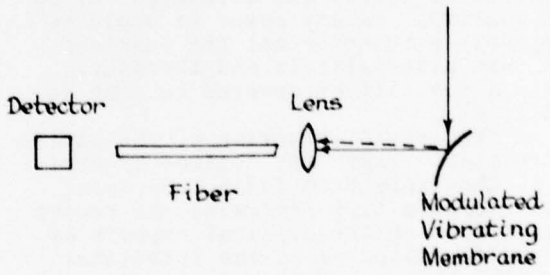

Figure 1. Direct acoustic modulation of light by a vibrating membrane and optical fiber.

Light is reflected from a sound-activated membrane and directed through a lens to a fiber-optic waveguide. The vibrating membrane changes the angle of light rays at the entrance to the fiber, and the degree of coupling, and hence emergent light intensity varies with sound intensity. Fromm claims to have obtained 50% modulation efficiency with this device.

Applications of acousto-optics devices as signal processors were discussed by several participants. For example, S.T. Kowel et al., (Syracuse University,

Syracuse, NY) described a two-dimensional acoustic processor that directly forms the Fourier transform of two-dimensional optical images. The image is focused on a quartz light valve through which two acoustic waves are travelling at right angles to each other. The valve is placed between two crossed polarizers so that unmodulated light cannot get through. The emerging light is modulated by the acoustic waves in such a way that the output contains a term which is proportional to the product of the original intensity and a sine wave. The sine wave contains the difference frequency and a wave vector which is equal to the sum of the original wave vectors. When this modulated light is detected, the detector photocurrent contains a difference frequency proportional to the $\bar{K}$ Fourier component of the incident intensity at position $\bar{r}$ where $\bar{K} = k_1\hat{x} + k_2\hat{y}$. Arbitrary Fourier components are generated by changing the transducer frequencies. The experimental instrument has a resolution of 15 line pairs/cm.

Several speakers addressed the problem of optical processing using noncoherent illumination. According to W. Stoner (Science Application, Inc., Bedford, MA), many difficult problems experienced with real-time processing using coherent spatial light modulators arise from the coherence. He explained how the optical transfer function (OTF) can be used in modified form to take the place of the Fourier plane filter in coherent systems. However, although Stoner has experimentally shown the basic principle to be valid, the development of suitable input and output techniques and devices must be carried out to make his ideas practicable.

On the same subject, G.L. Rodgers (Univ. of Aston, Birmingham, UK) pointed out by demonstration that noncoherent methods of Fourier transformation are less subject to severe problems resulting from errors in masks than are coherent ones.

Mathematical operations performed with optical techniques was the subject of three interesting papers. One of these by S.H. Lee (Univ. of California, San Diego) involves the use of coherent optical feedback in a confocal cavity containing a filter. He discussed the solution of Poisson's Equation with a time-varying inhomogeneous term. Lee claims this device has the advantages of very high speed, and of requiring no iteration or quantization of continuous variables. A readout device other than the present TV method is needed, however, to take advantage of the high-speed capability.

Two papers were presented on a new topic of performing residue arithmetic operations optically. J. Tsujiuchi (Tokyo Institute of Technology, Japan) outlined the basics of residue arithmetic for addition, subtraction, and multiplication using bases of numbers prime with respect to each other. A usable scheme for division has not been worked out yet. S.A. Collins, Jr. (Ohio State Univ., Columbus) described experimental work performed with two colleagues on an optical processor using prime residue arithmetic to perform addition. Their processor utilizes a controlled birefringence spatial light modulator (SLM) that causes relative phase delays between the fast and slow axis in the SLM. The authors constructed a prime residue system employing bases of 19, 20, and 21 that uses three light beams to represent a given number. Relative phase delays of multiples of $2\pi/19$, $2\pi/20$, and $2\pi/21$ radians are used respectively in the three beams. Addition of two numbers is carried out by two sequential operations with the three beams and two SLM devices in which the relative phase delays combine to produce the resultant addition.

Fiber optics and integrated optics (IO) devices, although usually used for communications, have application potential for analog and digital signal processing. This theme was the subject of a paper by H.F. Taylor (Rockwell International Science Center, Thousand Oaks, CA). He explained that IO devices can be used for analog-to-digital (A/D) conversion, logic operations, and computation, while optical fibers can fulfill the functions of signal delay and storage as well as for transversal and delay-matched filters. Combined filter and IO devices have potential applications as variable delay lines, pseudo-random sequence generators and programmable transversal filters. Such devices could provide an improvement over conventional techniques with which signal bandwidths are in excess of 100 MHz. Taylor has carried out experimental studies to show that some of the concepts work including an IO A/D converter and a 15-fiber filter.

It will be very interesting to see what happens in this field over the next few years. Certainly, the attendance

at this meeting was not large. However, as applications increase and proposed schemes are shown to be workable, interest in optical signal processing or optical computing should increase. (Vern N. Smiley and CDR Robert D. Matulka)

MATERIAL SCIENCES

MATERIALS RESEARCH AT THE ROYAL ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (RARDE)

Located in the rolling green hills of the North Downs, near Sevenoaks, Kent, is Fort Halstead, and within it, the Royal Armament Research and Development Establishment (RARDE). This is primarily an Army R&D lab, roughly equivalent to the Army Materials and Mechanics Research Center (AMMRC) and Watervliet Arsenal in the US. Approximately 2000 people work at RARDE, where I recently visited the Materials Branch which has about 80 workers (50 professional).

The Materials Branch is headed by Dr. Roger H. Warren, whom I was anxious to meet since he recently spent four years in Washington, DC on the UK Defence R&D Staff which is roughly a counterpart to ONR London. The Branch is divided into five sections that have awkward and redundant titles: Metallic Materials (comprising two sections: Gun Steels and Ammunition Materials), Corrosion and Metal Advisory, Metal Physics and Coating Technology, Mechanical Properties and Design Criteria, and Non-Metallic Materials. These titles give little insight into the actual activities of the sections, which tend to be keyed to several special areas of materials application, including gun barrels, penetrators, ordnance systems structures, and armor. The research work emphasizes mechanical properties of steels, weldable high strength steel structures, various penetrator materials, corrosion, and several other areas. In fact, the Materials Branch, as most of the 17 branches, has 3 roles: project support, long-term research, and consulting (including failure analysis). The project support role amounts to contributions to actual hardware development programs, while the long-term research involves fundamental work, although often with a sense of urgency, according to Warren.

In the area of gun steels, RARDE is deeply involved in alloy development, mechanical properties evaluation, fracture mechanics analysis, fatigue testing, and erosion/wear studies. Two sections, Metallic Materials, headed by D.J. Palmer, and Mechanical Properties and Design Criteria, headed by B.D. Goldthorpe, are involved in these aspects of the application. The principal materials of interest are electroslag-remelted (ESR) low alloy steels, such as of the Ni-Cr-Mo-V type. A program is underway to compare the fatigue lives of electroslag remelted hydraulic autofrettaged and swage autofrettaged gun tubes of Ni-Cr-Mo-V steels. The aim is to be able to predict tube life for the autofrettaged case, which is much more difficult than the nonautofrettaged one. Related projects are concerned with the experimental numerical determination of stress intensity factor calibrations for these geometries. Experimentally, a facility allows fatigue testing of actual segments of very large tubes, via hydraulic internal pressurization. They are interested in the effect of residuals such as sulfur and phosphorus on crack growth rates and have investigated this under various stress conditions; also the effect of tempering and elevated temperature service (350-650°C) on mechanical properties is of interest. The Mechanical Properties and Design Criteria section is concerned with the analytical aspects of this problem. The basic idea is to predict the safe life of internally pressurized tubes from knowledge of crack growth rates in small standard test pieces. The program includes the use of a potential drop method to measure crack growth rates in the test samples, as well as correlation with fatigue tests on full-size tube sections. It is reported that for nonautofrettaged tubes the results correlate well, but for autofrettaged tubes both the theoretical and experimental correlations are still under development. Actually, in the last few years, RARDE alloy development work has dramatically improved the fatigue life of gun steels to the point where the desired result, fatigue crack propagation all the way through the tube wall leading to leaks

before ultimate separation, has been obtained in full-scale tests.

In connection with their interest in gun steels, RARDE supports additional fundamental physical metallurgy studies at several universities, including structure-properties type work on ferrous alloys at Manchester and Cambridge. It should also be noted that RARDE has ready access to facilities for vacuum induction melting, casting, rolling, and forging; ESR steels can be prepared at the Royal Ordnance Factory, Patricroft.

Fracture mechanics analysis and experimentation is also applied to the situation for armor materials (so-called "target" materials). In Goldthorpe's section, E.W. Billington and T. Williams are carrying out work in the analytical and experimental regimes, respectively. Billington is developing a general theory for the mechanical properties of materials in relation to dynamic and static plasticity; his theory is based on fundamental rheological theory rather than simply on an extension of linear elastic theory to situations in which the mechanical response is nonlinear. Williams is concerned with the ballistic properties of target materials, both ferrous (ESR steels again), where the particular interest is the effect of trace elements, and nonferrous (Al alloys), where the effect of thermomechanical treatment is under study.

In another application area, critical load-bearing structures of ordnance systems, RARDE R&D emphasizes studies of precipitation-hardenable (PH) stainless steels. This work takes place under the direction of E. Jones in the so-called Metals Advisory section. One of the critical properties of interest is the fatigue strength of welded joints for these alloys, and the effects of weld practice and welding method are being investigated. Alloy development (based on the British FV520(S) PH stainless steel) is also underway; for example the effect of various alloying elements on the aging reaction is under study. Fundamental work on the fracture behavior of the welded alloy is also being studied under sponsorship at Leeds University.

One of the more exciting research areas involves the development of various novel materials for penetrators. For example, superplastic alloys for shaped-charge liners are of great interest currently. The basic properties and processing routes of copper shaped-charge cones and their effect on penetration is being assessed. The work tends to be rather empirical in nature, evaluating the effect of such parameters as alloy oxygen content, grain size, texture, and residual stress. In this vein, work on Pb, Zn-Al, and Cu alloys is also ongoing under the direction of Prof. J.A. Belk at the Royal Military College of Science in Shrivenham. Tungsten alloys and depleted uranium are also being studied at RARDE for conventional type penetrators.

The Corrosion section under the leadership of J.F. Andrew has a range of interests, including environmental cracking of ferrous and nonferrous alloys. Fundamental stress corrosion cracking (SCC) and corrosion fatigue studies are being sponsored at the Univ of Newcastle upon Tyne. Also crevice corrosion is of interest for a variety of metals and alloys in marine conditions. Work includes SCC testing (brasses, steels), studies of phosphate treatments for high strength steels, chromate conversion coatings for nonferrous alloys (brasses), and other means of corrosion protection.

One of the key areas of nonmetallic materials research involves filament-wound glass expoxy composites. An RARDE-developed computer-controlled (feed rates, angles, etc.) filament winding facility is used to produce various thin-walled tube configurations. These tubes are tested, and evaluations of failure modes and strain rate effects are made. This work is of an exploratory nature, since there are no current applications.

Arc plasma technology is an area of expertise at RARDE. Under the leadership of A.R. Moss, studies have been made into various applications of arc plasma operations, such as for welding, cutting, spraying, chemical reactions, and ablation testing. A versatile arc plasma facility has been developed at RARDE. Plasma processing is currently being investigated for use in treating boron carbide powders, the idea being to alter the nature of the particle surface and so produce changes in sintering behavior, for example by removing contaminant films and replacing them with novel catalytic materials. They are also exploring the application of arc plasma methods for deep water cutting and welding using a RARDE-developed deep-water simulator unit.

Other areas of interest to the Materials Branch include coating technology and failure analysis. In the latter case, there is a resident expertise in the specialized area of fragmentation and the analysis of fragments. This and other forensic techniques have been applied with notable success to a number of civil aircraft accidents, particularly those in which sabotage is suspected. This group, led by J. Markham, is particularly expert at identifying signs of explosive loading.

In summary, materials research and development at RARDE seem to be oriented toward satisfaction of certain specific materials demands of ordnance systems. There is an impressive capability expecially in the area of mechanical properties evaluation of high strength steels. However, a wide spectrum of materials science areas are evident: ferrous and nonferrous metallurgy, surface chemistry and corrosion, fracture mechanics, plastic and composite materials, etc. Where it is considered necessary to have deeper physical understanding of materials behavior, the work tends to be contracted out to universites, and these cooperative programs of extramural and in-house work seem to be quite productive. There are a variety of outstanding special test facilities at RARDE, mostly developed by the staff, including unique large-scale mechanical testing capabilities and various materials processing facilities. The R&D work is very much oriented toward current and near-term needs, and there is not much interest in the pursuit of basic mechanisms without some purpose. (Jeff Perkins)

THE 19TH INTERNATIONAL CONFERENCE ON COORDINATION CHEMISTRY—PRAGUE

This Conference, held at the Technical University of Prague, 4-8 September, attracted a record 1,000 participants. The meeting was under the sponsorship of the Czechoslovak Academy of Sciences and, in accordance with prevailing custom for these conferences, was opened by the Deputy Prime Minister of the host nation, who in his welcoming address mentioned that the Academy of Sciences has 10 institutes specializing in the chemical sciences and that there are 9 schools at the university level in Czechoslovakia specializing in chemistry.

The meeting's organization was along the following lines: Every morning there was a plenary lecture, and on several afternoons there were so-called "special lectures" by some of the "grand old men" in the field. These were meant to present reviews of the field and prognostications of research activities likely to flourish in the next two decades. After the plenary lectures the meeting divided into two parallel sessions for section lectures. Sometimes parallel with the section lectures, and on most afternoons, there were mini-symposia or panel discussions (it was difficult to tell one from the other) on a range of topics: "Coordination in Reaction Mechanism"; "Boranes as Ligands"; "Comparison between Metal Ion Catalysts in Chemistry and Biochemistry"; "Adducts of Bioxygen with Bioanalogous Substrates"; "Properties of Coordination Compounds in the Solid State—Influence of the Jahn-Teller Effect"; "Metal Complexes in Cancer Chemotherapy"; "Some Aspects of Homogeneous Catalysis"; "Theoretical Methods in Coordination Chemistry"; "Reactivity of Coordinated NO Group"; "Prebiotic Aspects of Coordination Chemistry." In the panel discussions the speakers had 20-30 minutes to present their talks, and this was sometimes followed by a general discussion. The mini-symposia/panel discussions usually lasted 2 hours. Alongside these various activities participants were encouraged to view the posters of the 550 contributed papers. All took place in a large and relatively new building of the Technical University, 2-3 miles from the center of the city.

It goes without saying that at a meeting of this magnitude just about all aspects of coordination chemistry were covered. In a few instances perhaps papers could have been more appropriately listed as organo-metallic chemistry. To this observer two areas attracted unusual attention: the catalytic properties of coordination compounds and the chemistry of coordination compounds that possess biological activity. In addition, there were a large number of papers dealing with the synthesis, chemical characterization, and the structure of coordination compounds. Especially among the invited lectures and within the symposia, there was considerable discussion of the mechanism of the reactions of such compounds. Last but not least, there were a number of papers dealing with the photochemistry of coordination compounds led off by a section lecture presented by Prof.

A.W. Adamson (Univ. of Southern California), a pioneer in this field. A small sampling of the papers follows.

In the first plenary lecture Prof. V. Gutmann (Technical Univ. of Vienna) gave a brief outline of his novel donor-acceptor approach to molecular interactions. Gutmann views molecules as being constantly affected by their neighbors except in the gas phase. He feels that he can explain much of the irregularities observed in reactions in solutions and also, to some extent, in the solid state by this approach. Thus, he feels it is wrong to consider a molecule as a rigid and inflexible entity. On the contrary, bond distances, bond angles, electron distribution, and reactivity are all affected by interactions between it and its neighbors.

A good review of the donor and acceptor properties of metallocenes and related compounds was presented by Dr. J. Klikorka (Institute of Chemical Technology, Pardubice, Czechoslovakia). In a talk, which was one of those crossing the boundary to organometallic chemistry, he discussed the chemical reactivities of the nickel, ruthenium, and other analogs of ferrocene. He pointed out that these sandwich compounds are strong proton acceptors, e.g., nickelocene has a proton affinity that is comparable to that observed in aliphatic amines. Such compounds and compounds of the metallocenes and carboranes, especially when they contain acyl substituents will also form complexes with Lewis acids (e.g., $TiCl_4$, $AlCl_3$, etc.). These complexes may be monomeric or dimeric depending on the particular system involved.

In another section lecture Prof. L. Sacconi (Univ. of Florence, Italy) presented a review of the present state of knowledge of coordination compounds that have a coordination number of five. He pointed out the unusual steric requirements for formation of this type complex and that a variety of ligands can be designed to form such complexes, many of them containing phosphorus. Structurally these complexes can be represented by a trigonal bipyramidal or a square-pyramidal structure and, for that matter, sometimes by geometries that fall between these two extremes. It should be noted in this connection that the bond angles are affected by temperature. He cited some examples where the substitution of one metal by another (keeping the ligand the same) also resulted in a considerable change in bond angles.

In his presentation on "Exchange Clusters of Transition Metals," Dr. Y.V. Yablokov (Academy of the USSR, Kazan) discussed the chemical physics of inorganic clusters with particular reference to thermodynamic factors, electronic configuration, steric factors, and their magnetic properties.

In his interesting section lecture Dr. S. Hermanek (Czechoslovak Academy of Sciences, Prague) reviewed the chemistry of transition-metal π-complexes of borane cages. He pointed out that these differ from organometallics by the extensive delocalization of the electron-deficiency inherent in the borane skeletons. These compounds undergo Friedel Crafts-type reactions by a "nucleophilic substitution under electrophilic conditions." Their halogenation and sulfhydrylation (by S + $AlCl_3$) also probably takes place by this mechanism. The bonds connecting the borane cages with the substituent groups are directed radially away from the cage, thus bridges may be formed by suitable substituents.

Prof. P.C. Ford (Univ. of California, Santa Barbara) presented a paper on the homogenous catalysis of the water-gas shift reaction by metal carbonyls. They find that the reaction proceeds smoothly in an alkyl containing $Ru_3(CO)_{12}$. Other transition metal carbonyls and in particular those with mixed transition metals have shown catalytic activity, and he feels that this process may find important applications in our efforts to utilize our coal reserves more fully.

Other section lecturers included Prof. F. Woldbye (Technical Univ., Copenhagen) who talked on the optical activity of coordination compounds and Prof. L.M. Venanzi (Federal Institute of Technology, Zurich) who is still interested in coordination compounds, although his present interests revolve around NMR studies, rather than synthesis, his interest 20 years ago. Venanzi discussed the use of Sr^{29}, Cd^{113}, Sn^{119}, and other metal isotopes for NMR studies of coordination compounds, pointing out that these isotopes occur in greater abundance than does C^{13} which has been used extensively in the last decade by organic chemists.

Among the large number of poster presentations dealing with catalytic activity, a complex of tungsten hexachloride and tetraphenyltin was found to catalyze the conversion of heptene-1 to ethylene and dodecene (H. Balcar, E.D. Babich, and T.A. Butenko, USSR-CSSR). Another catalyst proposed by a French group was based on nitrosyl-carbonyl de-

rivatives of iron and cobalt (D. Ballivet-Tkatchenko, et al., Institute of Catalysis, Villeurbanne, France). J. Bartoň (Institute of Polymers, Slovak Academy of Sciences) reported that a donor-acceptor complex from nickel chloride and dimethylaniline was effective in the free radical initiated polymerization of acrylates and methacrylates. N.V. Borunova and L.K. Freidlin (USSR) reported that the tin hydride complexes of platinum metals, especially when they are bonded to phosphine ligands, are effective catalysts for hydrogenation reactions, double bond migration and cis-trans isomerization of octenes. The Hungarian group of F. Joo, Z. Toth, and M.T. Beck reported on the catalytic properties of transition-metal sulfonated triphenyl phosphine complexes. They find that compounds of this type are effective in hydrogenation reactions in aqueous media and have carried out some kinetic studies on the hydrogenation process. (Their preliminary work in this area was published in *Inorganica Chimica Acta* last year). Drs. I.O. Lo and A.D. Zuberbühler (Basle) reported on the copper (+2) catalyzed oxygenation of active methylene groups in organic compounds. Dr. Z.M. Michalska (Lodz, Poland) found that aluminum compounds were catalytically active in the silyiations of silanols in benzene solutions. Nitrogen fixation by catalytic techniques were reported by two groups: D. Sellmann and W. Weiss (Paderborn) who found that a cyclopentadiene manganese dicarbonyl was effective for this purpose, while a group from Wroclaw, Poland reported that a complex formed between suitable organometallic compounds and molybdenum tetrachloride was effective for this purpose. Finally evidence that some of the chemical reactions that are catalyzed by metal complexes proceed by a trimolecular complex mechanism was presented by a research group from the Czechoslovak Academy of Sciences under Dr. D.M. Wagnerová.

On the synthetic side the preparation and characterization of a new family of compounds consisting of boranes and iron ("ferroboranes") was reported by Prof. T.P. Fehlner (Notre Dame), while in the field of organometallic chemistry Dr. G.A. Domrachev (USSR Academy of Sciences, Gorky) discussed the equilibria involved in the direct synthesis-decomposition of organometallic compounds from their constituents. Another group of Soviet scientists (S.V. Larionov, et al., Institute of Chemical Kinetics and Combustion, Novosibirsk) described the synthesis and properties of transition metals with stable organic radicals containing one or more paramagnetic centers, noting that magnetic susceptibility measurements on the complexes in the solid state indicate that the unpaired electrons of the ligands are present in the complexes that are formed. The basicity and complexing ability of multi-functional polymers with a para- (amido-amine) structure was discussed by Drs. V. Barbucci, V. Baroni and P. Ferutti (Univ. of Naples, Italy) who find that, in general, the basicity constants of the polymers are slightly lower than those of the corresponding dimers or trimers. They also find that several polymers form complexes with divalent copper. The introduction of lanthanide metals into organo-mercury compounds was reported by G.S. Kalinina et al. (USSR Academy of Sciences Laboratory, Gorky). They found these compounds are readily formed in ether solution and are decomposed by HCl. The synthesis of a series of novel metal clathrates was described by J. Chomic et al., (Kosice, Czechoslovakia), their nature being confirmed by ir spectroscopy. Finally the synthesis and crystal structure of a new poly-tungsten cryptate containing 40 tungsten atoms was reported by a research group from the Univ. of Paris under the direction of Dr. M. Leyrie.

Attendance at this meeting was roughly evenly divided between scientists from western countries, from Eastern Europe and from the countries of the Third World. It is quite obvious that international meetings that are held in "socialist countries" get a far better representation from that part of the world than do similar meetings held in Western Europe. [George M. Wyman, US Army Research and Standardization Group (Europe)]

ONRL REPORTS

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SEVENTEENTH (INTERNATIONAL) SYMPOSIUM ON COMBUSTION

The Seventeenth Symposium (International) on Combustion convened at the Leeds Univ. in England, 20-25 August 1978, with the presence of over 1000 scientists and engineers from all over the world.

The Symposium consisted of three colloquia "Fire and Explosion," "Coal Combustion," and "Turbulent-Combustion Interactions" and sessions on Deflagration to Detonation Transition, Kinetics, NO_x - SO_x, Furnace Combustion, Inhibition and Ignition, Engine Combustion, Flame Structure and Chemistry, Droplets Combustion, Combustion Oscillations, Combustion Studies, Soot, Measurement Techniques, and Propellents and Explosives. The general level of the meeting seemed inferior to that of the Sixteenth Symposium held in Cambridge, MA, two years earlier, and there were fewer outstanding papers. Nevertheless, the Combustion Institute and the organizing committees are to be congratulated for drawing together so many prominent combustion scientists.

There were three simultaneous sessions with every session heavily attended. Further, one must note the extensive discussions that took place in the hallways, during coffee breaks, and even at the social events. Consequently, it was impossible for any one individual to hear all papers, so this review will focus on only certain of the subjects presented. Comments will mainly cover the Colloquium on Turbulent-Combustion Interactions, and the sessions on kinetics, NO_x - SO_x, Droplets, Soot, and Measurement Techniques.

In many ways the basic material in the various sessions to be analyzed are related. Essentially there are three themes on which to concentrate: turbulent combustion, NO_x, and soot. As evidenced by the numerous papers presented and the background of the authors, turbulent combustion has provided the entree for fluid mechanics researchers into combustion. In many ways this subject was evaluated more succinctly at the Project SQUID Workshop on "Combustion Measurements in Air-Breathing Propulsion Engines" held at Purdue in 1975. NO_x is thought to be of primary concern because of its formation in gas turbine engines and the environmental restrictions placed on its manufacture. Elements pertinent to NO_x are related to material presented in the sessions on Turbulent Combustion, Kinetics and Droplets, as well as the NO_x - SO_x session. Further, one of the longer term concerns must be the ability to burn fuels that are "heavy" and highly aromatic. Such fuels produce large amounts of soot which can be disastrous to the lifetime of the combustor chamber in an aircraft gas turbine and which can make testing difficult and expensive owing to environmental restrictions. Also, the soot problem is of primary interest in any operation of a diesel prime mover, another power plant of general importance. Many believe that the understanding of soot formation and destruction processes will be of primary concern to combustion scientists in the next decade. There was an irony in the organization of the Symposium in that the plenary lecture (truly excellent) was devoted to this topic, but only one session was and that on the last day of the meeting. Of course, the small number of papers could indicate that interest in the subject is just being initiated. The papers by Haynes, et al. and Magnussen, et al., in the soot session provided some of the more dramatic results of the whole meeting. The other particular paper that must be cited was that by Johnson, et al., on "The Presence of NO_2 in Pre-Mixed Flames." They may have resolved an important question with respect to the extent of NO_2 production in combustion processes.

Although placed in the Colloquium on Turbulent-Combustion Interactions, three papers belonged elsewhere. The one by Sangiovanni and Dodge "On Observations of Flame in the Combustion of Monodispersed Droplet Streams" should have been in the session on measurement techniques. The experimental high-speed photographic procedure described by these investigators is indeed unique in that it utilizes a 35-mm camera which has been modified to include an ITT Model F-4112 image intensifier tube with a 25-mm format. Photographs of burning droplets heretofore not possible have been taken. The droplet procedure and measurement technique hold important consequences for the understanding of NO_x and soot formation in spray configurations. Likewise, a paper by Nizami and Cernansky on "NO_x Formation in Monodispersed Fuel Spray Combustion" should have been in the NO_x session and the paper by Hsieh, et al., on "Diesel Odor Studies in a Laboratory Spray Burner"

because of its technical significance belonged with the papers either in the NO_x - SO_x session or the Soot Session. They showed that the odor from burners simulating the diesel process was more likely from (unburned) oxygenates than (exhausted) aromatics.

The more technical aspects of this review will begin by considering the papers related to the problem with respect to soot formation. This reviewer will paraphrase the soot process conceptually from what may have been inferred in the plenary lecture, "Soot Formation in Combustion: A Review," by H.C. Wagner. The amount of soot formed in a process is the result of a sequence of steps: the pyrolysis of the fuel, the formation of gas-phase large precursor molecules, nucleation, particle growth, agglomeration and coagulation, and partial oxidation of the particulates.

The process of the precursors has been studied in the greatest detail. As Wagner stated, fuel molecules are attacked by radicals, hydrocarbon radicals are formed, can combine or react with hydrocarbons and form new hydrocarbons with less hydrogen. These hydrocarbons contain double and triple bonds and exist because of the greater thermodynamic stability of unsaturated hydrocarbons at higher temperatures. Polyacetylenes form and have been identified, and the formation and growth of polycyclic hydrocarbons follow. This reviewer believes that this procedure holds for both aliphatic and aromatic fuels in premixed flames. The aromatic structure is ruptured early in the oxidation process and later reformed in the soot formation process. In diffusion flames, however, the aromatic fuels could retain their ring structure as the precursors develop and dehydrogenate.

Wagner also noted that the carbon particle in combustion systems can be removed by oxidation with OH, O or O_2. He concludes that the process is slow compared to the gas phase oxidation of the fuel molecules and that in systems with short residence times particles have a good chance of surviving and being exhausted. However, the oxidation rate of high temperature, small soot particle is not well known and may be faster than one believes. The key to whether soot once formed will be burned depends on three factors: the residence time of the particle in a combustion atmosphere, the size of the particle, and its temperature. Herein lies the tremendous significance of the results presented in the paper by Haynes, et al., on "The Effect of Metal Additives on the Formation of Soot in Pre-Mixed Flames". The general belief has been that the addition of the alkali and alkali-earth metals reduces soot formation. It has been shown in this excellent paper that the amount of soot is not reduced by the additive, but the size distribution is altered. Essentially when the alkalis are added, one obtains smaller particles, but more of them. The observation that the additives decreased the amount of soot simply reflects the fact that many particles were too small to see. Haynes, et al., showed that the effectiveness of the additive was directly related to the ionization potential of the metallic component, the lower the ionization potential the greater the effectiveness.

The explanation of the effect is that the soot particles become charged owing to the metal ionization process, repel each other and thus agglomeration is substantially decreased. Of course, in a properly designed combustion system this effect can be used to reduce the total mass of soot being exhausted by burning up these very small particles. Indeed, it would appear then that, if one is interested in reducing soot formation, he should be most concerned with the fuel pyrolysis and the soot burn-up processes.

The results of Magnussen, et al., in their paper entitled "Effects of Turbulent Structure and Local Concentrations on Soot Formation and Combustion in C_2H_2 Diffusion Flames" reflect on the importance of fuel pyrolysis step. The authors show that the addition of water and N_2 to the fuel in a diffusion flame reduces soot formation. Because of the large dramatic effect of water, they argue that there is a chemical effect due to the water.

This reviewer has to disagree with that conclusion and argue that considered on a molar percent basis, the effect of water is thermal and arises from its much greater specific heat (it lowers the temperature and reduces the pyrolysis). The turbulence modelling discussed by the authors and its effect on the soot production cannot be accepted either. By using a turbulent diffusion flame, instead of a laminar one, the authors interrelated the fuel pyrolysis and soot burn-up steps. Indeed, as noted,

Reynolds number may have a strong effect on soot formation due to the observation that decreasing Reynold's number increases soot formation. The authors argue that this effect cannot be explained as a function of residence time, but must also be attributed to the fine structure of the turbulence. However, turbulence induces zones of diffusion flames very much like premixed flames and increases the oxidizer concentration around the soot particles causing faster burn-up. Perhaps this is what they meant by the fine structure effect.

The importance of the aforementioned work of Sangiovanni and Dodge to the soot problem comes about with the visual ability to observe spacing of droplets whose flame structure interact when droplets are close enough so that in a flow system one droplet is in the wake of another. The wake becomes a very fuel-rich zone not enclosed by an oxidizer field and is more prone to soot formation.

In the Colloquium on Turbulent-Combustion Interactions, Bray presented an excellent exposition entitled "The Interaction between Turbulence and Combustion." This reviewer attended only a very few of the total papers in the Colloquium. From review of the abstracts and discussion with participants it is very difficult to pinpoint any significant advancement that developed at the meeting on the state of understanding of this terribly complex problem. The central thesis, which seems to concern many and which essentially was the focus of the Bray paper, is, quoting from Bray "...the interaction between turbulence and combustion is a two-way, coupled process, with turbulence influencing combustion and combustion influencing turbulence." By the nature of the problem, the field of turbulent-chemical reaction rate interaction seems to have been taken over by researchers whose main area of interest has been fluid mechanics. The critical concern is how the turbulence affects the chemical reaction—in a more simplistic sense, how close is the instantaneous reaction rate to a time-averaged rate.

Bray elegantly showed what is demanded to solve the problem in an exact way and the simplification which comes about when the reaction rates are very fast compared to the turbulent exchange rates. An important question raised by this reviewer at the Symposium is whether there is any practical combustion problem in which the characteristic time of the chemistry is never very much shorter than the characteristic time associated with the turbulent exchange process (fluid mechanics). Only one problem has been proposed and that is the nitric oxide formation process from atmospheric nitrogen only. One should consider this fact and much of what was in the review presented by Mellor entitled "Turbulent Combustion Interaction Models for Practical High Intensity Combustors" in which the problems of liquid phase burning were introduced. This reviewer then concludes that the theoretical aspects of the turbulent combustion process and the extended experimental effort to make measurements of a turbulent field going on and being proposed in order to verify various of these theoretical approaches as being much overdone and essentially hypothetical problems. The turbulent burning of liquid sprays is a very, very complex problem and what was presented at this Symposium should be considered in light of the discussions and papers at the previously mentioned Project SQUID workshop.

The experimental measurement of NO_x from practical combustors has been studied for many years. However, there are still some important unsolved problems, and presentations made at the Symposium showed that progress is being made. A question that has remained unanswered is whether the NO_2 concentration measured in many combustion experiments was that which actually exists in the flow field or whether the NO_2 formed in the sampling probe. The paper by Johnson, et al., on "The Presence of NO_2 in Pre-Mixed Flames" gives further evidence that the NO_2/NO ratios determined by probe techniques are principally the consequence of reactions that produce NO_2 in the probes. Some results by Oven, et al., "Temperature and Species Concentration Measurements in a Swirl-Stabilized Combustion" seem to dispute this conclusion, however.

Fenimore in his paper "Studies of Fuel Nitrogen Species in Rich Flame Gases" continues to contribute further to the understanding of the NO formation problem from fuel-bound nitrogen species by reporting that the oxidation of HCN formed in combustion processes is destroyed mostly by hydroxyl radical and that the biomolecular rate is of the order of 10^{12}. He reported additionally

that the biomolecular rate for reaction of NH_2 radicals with NO is $5(\pm 30\%) \times 10^{12}$.

Using precise shock tube techniques, Monat, et al., in a paper entitled "Shock Tube Determination of the Rate Coefficient for the Reaction $N_2 + O \rightarrow NO + N$" showed that they have reduced the uncertainty of this rate coefficient. For the temperature range 2384-3850 K they report a pre-exponential factor of 1.84×10^{14} and an activation energy of 78,250 cal/mole.

In the previously mentioned paper by Oven, et al., it was reported that large amounts of NO_2 were present in a swirl burner which consisted of a premixed fuel-air mixture concentric with an outer air stream. Both streams had an imposed swirl. They also found a systematic variation of the NO_2/NO ratio at many locations in their burner. The large amounts of NO_2 were observed in the cooler regions of the flow outside and downstream of the recirculation zone. These results would be consistent with the belief that NO_2 reduction reactions are quenched.

Nizami and Cermansky in their paper on "NO_X Formation in Monodisperse Fuel Spray Combustion" reported experimental results that indicate that the NO_X formation in the spray of isopropyl alcohol is affected by droplet diameter, equivalence ratio, fuel field rate, and by the distribution of dispersion and dilution air. The most significant effect is the decrease of NO_X with droplet diameter, which reaches a minimum around 50 μm and then increases. They attribute this minimum to transition from a diffusion flame to premixed burning.

In conclusion this reviewer would like to state that undoubtedly there were other worthwhile papers presented which he was not privileged to hear. The technical activity at the Symposium precluded any one person from attending all papers. For creating such a high-spirited technical conclave the Combustion Institute is to be congratulated. (Irvin Glassman, Center for Environmental Studies, Princeton University, Princeton, New Jersey)

TOUGH PLASTICS

Within the short period of four months, between the first of July and the end of October of 1978, there were three conferences in London on the fracture of polymers. So much interest in this less than earth shaking topic does not signal a crisis in the durability of plastics. Rather, it indicates that there are new and very practical motives for research on why and how plastics, i.e., solid polymers, fail. The principal motivation is oil conservation. Petroleum is more efficiently used when it is converted into petrochemicals and plastics than when burned as fuel. Plastics can be used to replace metals which saves energy because the refining and fabrication of metals are very energy intensive processes.

A second motivation for research on polymer fracture is its importance to the strength of polymer matrix-fiber reinforced composites. These materials, with their high strength-to-weight and stiffness-to-weight ratios compared to metals, are replacing aluminum and titanium in aerospace construction and are very likely to be used in automobile and railcar construction for both weight saving and to replace high energy content metals.

Plastics have a reputation, often deserved, for brittleness. Especially when compared to metals which, because of their ductility, have considerable resistance to fracture from surface scratches or internal flaws. The plastics industry has made considerable advances over the past 20 to 30 years in improving the fracture resistance of polymers. The most progress has been in developing two-phase materials in which the polymer contains a few weight percent (<10%) of rubber dispersed as particles a few μm in diameter. The enhancement in the fracture resistance of the matrix polymer can be as much as 50 fold and sometimes greater. An example of a two-phase polymer is high impact polystyrene (HIPS).

The conferences in London dealt with the scientific, and to a lesser extent the technological, aspects of the fracture of both toughened polymers and the base, unmodified polymers themselves. The first conference, Toughening of Plastics, was held on 4-6 July and was sponsored by the Plastics and Rubber Institute (PRI) with Dr. C.B. Buchnall (Cranfield Institute of Technology, Beds.) as

chairman. This meeting was intended to be international in scope, but the speakers and audience were almost entirely from the UK and US.

The second meeting, held on 18 October, was also sponsored by the PRI but was a mini-conference on the rather specialized topic of Crack Propagation Stability in Thermosetting Polymers. Nonetheless, this meeting attracted a crowd of over 50 attendees from UK universities, industrial R&D groups, and local students, that overflowed the small meeting room. Such a broad spectrum of attendees at a specialized discussion meeting reflects the strong interest in polymer fracture. The meeting was organized and chaired by Dr. A.J. Kinloch [Propellants, Explosives and Rocket Motor Establishment, (PERME), Waltham Abbey].

The third conference, held on 31 October, was entitled The Physical Basis of Toughness in Homogeneous Polymers, and was sponsored by the Society of Chemical Industry and the Institute of Physics. It was organized by Prof. R.N. Haward (Univ. of Birmingham), and the morning session was chaired by Prof. E.H. Andrews (Queen Mary College, Univ. of London) and the afternoon session by Prof. G. Allen (Chairman, Scientific Research Council). Attendance was about evenly split between university and industry (predominately from the UK), but all the speakers were from academia.

It is useful to touch on some of the highlights of these conferences because they indicate the current state of polymer fracture research. Historically, much of the early (1950s) polymer fracture work was done to model the fracture behavior of metals. In tests on transparent plates of polymethylmethacrylate (PMMA), the events at the crack tip could be observed, and it was assumed that similar events take place in cracking of metals. This assumption has serious limitations since the crack tip deformation mechanisms in plastics and metals are quite different.

However, there now exists a sizable community of fracture mechanists involved in polymer fracture. Their interests are not generally aimed at modeling metal fracture but in developing fracture mechanics failure criteria for polymer structures. These folk take a continuum mechanics point of view and tend to ignore the molecular events at the crack tip which determine polymer toughness.

On the other hand, there is a contingent of polymer scientists interested in the molecular mechanisms involved in polymer failure and specifically the energy dissipation processes that occur in the high-stress field at crack tips.

Both the continuum mechanics and the molecular mechanisms people were evident at all three London meetings. More importantly, they were speaking to each other and, in fact, sometimes trying to speak each other's language. This situation represents a benchmark in polymer fracture research.

Thus, it was somewhat surprising to find Prof. J.G. Williams (Imperial College of Science and Technology, Univ. of London), an avowed continuum mechanist, giving a lucid overview of the micro-deformation mechanisms that can occur at a crack tip under an applied stress. In his talk at The Physical Basis of Toughness in Homogeneous Polymers Conference he suggested that the geometry of crack-tip deformations can be categorized into three general types. The first involves the simple forward extension of a craze from the end of the crack (Figure 1). Crazes form in

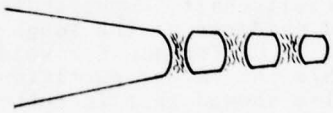

Figure 1.

thermoplastic (noncrosslinked) polymers when mechanical stress creates a microvoid which, as it grows, develops ligaments of polymer across the cavity. The craze continues to grow until the failure strength of the ligaments is exceeded.

The second type of deformation involves shear yielding within some characteristic volume at the crack front. When the material within this volume reaches its failure strain, the crack advances. Crazing may also occur at the crack-tip opening but because the shear yield stress is lower than the crazing stress, the principal deformation mode is shear failure (Figure 2).

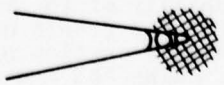

Figure 2.

Finally, Williams' third type of crack-tip deformation allows subsidiary crazing or other localized deformation to be superimposed on shear yielding and crack-tip crazing. This category would include the elastomer-modified polymers such as HIPS (Figure 3). The

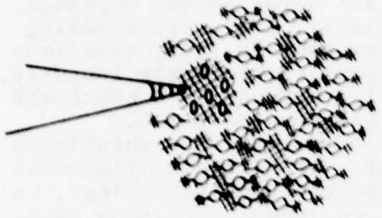

Figure 3.

polystyrene matrix deforms by shear yielding and crack-tip craze formation, but in addition the dispersed rubber particles induce localized crazes. It is this additional information that gives HIPS its high toughness compared to the unmodified polystyrene.

Although it is generally accepted that the rubber particles in HIPS induce localized crazing, Dr. F. Haaf (BASF Aktiengesellschaft, Lugwigshafen, FRG) presented evidence at the Toughening of Plastics Conference for void formation within the rubber particle itself. He also showed that in rubber-modified polyvinylchloride the rubber particles induce localized shear yielding rather than crazing.

The high impact strength of rubber-modified thermoplastics is not reflected in their resistance to cyclic fatigue stresses. This deficiency is not evident in testing notched specimens in which it is found that the rubber additive inhibits the propagation of a long deliberate crack. However, at the Toughening of Plastics Conference, Buchnall reported on his fatigue tests of unnotched specimens of acrylonitrile-butadiene-styrene (ABS). The ABS underwent a rapid decline in modulus which Buchnall attributes to cumulative shear damage that causes an accelerated heating of the polymer and eventually ductile failure. At low stress levels the ABS undergoes a brittle failure that appears to be due to an inability of the rubber inclusions to inhibit the growth of microcracks. Buchnall is continuing his fatigue studies using ABS and also a rubber-modified polyphenylene oxide in which the shear banding and other deformations can be more easily observed than with ABS.

The rubber-toughened thermosetting polymers, notably the carboxy-terminated butadiene acrylonitrile (CTBN)-modified epoxies have not been studied nearly as much as their thermoplastic cousins. Although crazing has been suggested to occur in epoxy polymers, it has been difficult to observe. Shear yielding does occur, and the rubber particles in the CTBN-modified epoxies induce localized yielding; there is also void formation within the particle itself. These are similar to Haaf's findings with the rubber-modified thermoplastics.

At the Toughening of Plastics Conference, evidence was presented by Dr. P.W.R. Beaumont (Univ. of Cambridge) and Dr. D.L. Hunston (Naval Research Laboratory, Washington, DC) that the rubber particle in the CTBN-epoxy elongates and ruptures as the crack tip opens. Later, in the meeting on crack stability, Beaumont suggested that this elongation process contributes only a small part, less than 10% to the toughness of the rubber-modified epoxies.

The meeting on Crack Propagation in Theromosetting Polymers was called to discuss the question of why epoxy polymers sometimes fracture catastrophically and at other times the crack advances in a smooth, stable fashion. From the point of view of structural reliability, stable propagation is much more desirable than catastrophic failure. The pivitol presentation was given by Dr. Robert J. Young (Queen Mary College Univ. of London) on his work with Dr. Kinloch [see *Polymer* 19, 574 (1978)], where they found transitions from unstable propagation in epoxy with increasing strain rate, decreasing temperature, and that the type of propagation depended on the choice of cross-linking agent. Young and Kinloch suggest that if the material at the crack tip can yield without significantly blunting the crack tip, then fracture is stable, but if plastic flow of the polymer blunts the tip, fracture is delayed until the failure strain is reached and the crack pops forward. Dr. Clive Phillips [Atomic Energy Research Establishment (AERE, Harwell)] presented similar results on stable and unstable fracture of epoxy polymers, but he was most disturbed by the fact that he could not obtain repeatable results from the same batch of epoxy polymer. The principal conclusion of this discussion meeting was that there are still many unresolved questions about the fracture of thermosetting polymers.
(Willard D. Bascom)

MECHANICS

FLUID MECHANICS AT THE TECHNISCHE UNIVERSITAT MUNCHEN

The program in fluid mechanics at the Technical University (TU), Munich, is under the direction of Professor Erich Truckenbrodt. During my visit there, I not only had the opportunity of meeting with him but with part of his staff, namely, Dr. Rainer Friedrich, who holds the title of Wissenschaftlicher Rat, which corresponds to the level of Reader in English universities and Assoc. Professor in the US; Ingenieur Reinhard Voges, who is a lecturer and research assistant; and Ingenieur Hans Wengle, who is a research assistant.

A good percentage of the activity at the TU is concerned with the study of turbulence. In this regard, Voges discussed his particular activity, which consists of studying various models of turbulence including different closure schemes as proposed by Rotta, Spalding, and Launder. Voges has been utilizing extensive experimental data to evaluate relevant parameters in these schemes so that he could then go on with his study of the turbulent incompressible boundary layer with favorable and unfavorable pressure gradient. Wengle has been studying numerical methods for partial differential equations in general, and in particular has been exploring the use of the fast Fourier transform for nonperiodic boundary conditions applied to such problems as air pollution. Wengle has considered a line source of pollutants in a shear flow and has been trying to calculate the concentration distribution downstream of the source. With contaminants having a different density than that of the air, the effect of gravity in a direction perpendicular to the flow is also included in an attempt to model the earth's boundary layer. The turbulent diffusion of contaminants is also modelled via a closure scheme on a subgrid scale. Besides turbulent diffusion, Wengle is also attempting to include the effects of chemical reaction in which the reaction time is large compared to the typical time in passing a grid length, but short compared to the time scale of the entire problem being studied. Other problems being modeled by Wengle are a two-dimensional boundary layer over a step representing surface roughness, and a jump in temperature or heat flux at the boundary. Naturally, the structure of the turbulence changes with accompanying changes in mass transport as the boundary roughness and/or temperature jump influence the flow. Whether a closure scheme utilizing parameters that are not typical of these types of flow can ever model such a flow is questionable.

Friedrich is attempting to model the unsteady turbulent boundary layer using a closure scheme due to Peter Bradshaw, of the Imperial College of Science and Technology, London, UK. This scheme includes continuity and the Reynolds equation, along with the turbulent energy equation, and the solution is via an integral method. Friedrich has just started on a joint research program with Professor N. Rudraiah, of the Indian Institute of Sciences, Bangalore, India. The problem they are embarking on is a study of convective stability in porous media saturated by a fluid. They are attempting to obtain the onset of the instability and the formation of a cellular structure of the diffusive flow field by the use of Fourier expansions in the eigenvalues.

An interesting problem in the rheology of two-phase flow is under investigation by Ingenieur Hans Immich. He is studying the flow of a suspension of spherical particles in a liquid that includes the effects of particle rotation. It is clear that the vorticity of the flow interacts with the rotation of the particles, and for sufficiently small particles, Stokes flow about them gives a good approximation to the flow in their neighborhood. Immich is applying the resulting equations for such a mixture to the solution of the flow field about an infinite plate which is surrounded by the fluid and is suddenly accelerated in a tangential direction. This problem was first studied by Stokes for the case of an ordinary (Newtonian) viscous fluid.

Ingenieur F. Matyas is studying peristaltic pumping of fluid in a tube, first considering nonviscous and then viscous flow.

Truckenbrodt's group is cooperating with local industry in the study of environmental flows and of flow about buildings. Instrumentation has been placed at the Munich TV tower to study the turbulence caused by the tower and its movement owing to vortex shedding.

Wind pressure distribution about models of projected buildings is measured in the TU wind tunnels in order to obtain the wind loading on the structures and so assist in this structural design. In addition, distribution of wind velocity in passages between buildings is obtained to assist in the modification of the design to reduce any undesirable effects. The air intake and exhaust systems of the buildings are also checked in the wind tunnel to make sure that the building exhaust is not ingested by the tunnel.

The Department has two Göttingen open test-section closed-return wind tunnels which it uses for industrial problems. These tunnels are capable of velocities up to 70 m/sec and have test sections 1 m in diameter. There is also an Eiffel-type wind tunnel with a closed section and an open return having a test section 2 × 1.5 m in cross section and a velocity of 25 m/sec. This tunnel is being used to study the concentration of contaminants in flow over models. In addition to the foregoing, there is a channel for flow visualization studies and a Göttingen-type student wind tunnel capable of 60 m/sec with a circular test section 1.2 m in diameter. (Martin Lessen)

PHYSICAL SCIENCES

TOWARD A MORE PERFECT UNION OF PHYSICISTS—THE EUROPEAN PHYSICAL SOCIETY CELEBRATES ITS FIRST DECADE

The European Physical Society (EPS) met in York, England, for a general meeting that marked the tenth year of its inauguration on 26 September 1968. This may be an appropriate time to describe briefly this organization and the role it plays at present in European Physics. In anthropomorphic terms 10 years is half way to maturity, and perceptive observers sometimes feel that they can foresee the mature adult in the image of the child. Perhaps, then, some outlines of the future impact of EPS on European science may be apparent even now.

Europe has developed a surprisingly large amount of scientific cooperation among nations. Large accelerators with multinational staffing and funding exist and are successful; there is a European group concerned with atomic energy; a new multinational facility for plasma fusion research is well on its way, and discussions are progressing on the subject of a large European source for synchrotron radiation. All of these efforts impress on European physicists the conclusion, reached also in such diverse areas as agriculture and airplane production, that the countries of Europe have much to gain by working together.

EPS is a supernational body that includes members from 28 national physical societies of Europe stretching from Israel to Norway and from Eire to the USSR. These national societies have a remarkable divergence. The largest is The Institute of Physics in the UK with 16,000 members and a strong program of publishing and organizing meetings. Following in size are the West German Physical Society with 7000 members, the French Physical Society with 3000 members, and the Italian and Dutch with memberships of about 1000 each. The ability of national groups to provide for their members' needs obviously varies widely.

EPS is subdivided into eight Divisions: Astronomy and Astrophysics, Atomic Physics, Computational Physics, Condensed Matter, High Energy and Particle Physics, Nuclear Physics, Plasma Physics, and Quantum Electronics. The two largest of these Divisions, Atomic Physics and Condensed Matter, are further subdivided into sections. Each part of the organization has a director and an advisory board.

A principal activity of EPS is concerned with technical meetings, which go on at many levels. There are the large general meetings every 3 years of the EPS itself such as this one (EPS4) at York. The Divisions have meetings of their own as well. (See *ESN* 31-9:351 for a description of the last meeting of the Condensed Matter Division.) In addition, EPS joins in sponsoring specialist meetings and gives strength to symposia held in conjunction with national society meetings. EPS sponsorship of a meeting tends to exert a moral force for broadening its base and making it high in quality. Before sponsorship is given they must be assured of the quality of the meeting, that a sound refereeing system exists, that an international committee advises on the program, that more than half of the invited speakers come from outside the host coun-

try, and that a broad international attendance will exist free of restriction. About 40% of the technical meetings in physics in Europe now have EPS sponsorship.

EPS is not yet involved directly in publication except for its monthly newsletter, sent to the 3000 direct dues-paying members and subscribers, and its abstracts of papers from various conferences. However, it takes a strong advisory position here as well. A committee survey found that there are 464 physics journals published in Europe of which only a minority are truly international. The publications committee has selected 35 for the award of its Europhysics emblem that shows that these journals are recognized as having a European board of editors, a high standard of refereeing, and a wide circulation. Members are advised to publish in these journals and to recommend them to their libraries. The attempt is being made to establish fewer, cheaper, and stronger journals in Europe to counteract the tendency to publish the more important European work in American journals, such as the *Physical Review* and *Physical Review Letters*. The EPS Council has agreed that the eventual future publication policy of the Society will be to promote a single, coherent set of general, specialist, and review journals containing between 10 and 15 titles, as being advantageous from both the scientific and economic points of view.

So how does European physics go from 464 journals down to 15? The glib answer is—with difficulty! It is at a point such as this that the future role of EPS may be decided. Is it to be a loose confederation of national societies serving only to step into areas of international activity that the national societies permit? Or will it become preeminent in Europe leaving the national societies to slowly fade away? The answers are not now clear. The large national societies form an extensive and familiar group with meetings where friendships are renewed, a comfortable language is spoken, and staff and students look for employment opportunities. A great deal of national pride goes into the journal publications of these societies. For many of the younger physicists with international experience, the larger European view is more attractive, and they feel that EPS needs to assert itself as the organization that produces really first-class international research meetings and journals. EPS has been careful to work with the national societies and not to supersede them. Cutting down on society journals or amalgamating them will strike directly at a cherished national Society activity. It seems to me likely that the outcome of the struggle over journals may determine the role EPS will play in the future.

To complicate matters still further, several commercial publishing companies are now well established with their own technical journals. One of these publishes over 10,000 pages of technical journals a year. How should they fit into a future plan?

EPS plans to step into the publishing business itself in a year or two. In a joint venture with the British Institute of Physics it will establish a *European Journal of Physics* devoted to the teaching of physics.

One last very new activity of EPS deserves mention. It is beginning to sponsor a program of scholarships for students to study in countries other than their own. Through the EPS, Italy has just instituted 10 scholarships for students to come and do research for a year in Italy. A few other countries are also involved in this program and more will probably join when they have time to consider the program and find funding for it.

How do Europeans feel about EPS? Most of the comment I have heard was to the effect that it was moving too slowly in establishing leadership. From discussions with some of those most responsible for the actions of the Society, it seems that EPS is content to exert a steady force for internationalism and to anticipate that this will win over the minds and eventually the hearts of most European physicists. As an outsider I was rather impressed with the progress made by EPS in a decade and the skill and care with which its future is being developed.

The meeting itself was divided between plenary sessions, in which topics of general interest were presented at some length, and specialist meetings in smaller and more intimate groups. These smaller symposia were concerned with the following topics: Modern optics, surface physics, phase transitions, nuclear astrophysics, hot plasma in space and laboratory, heavy ion physics, synchrotron radiation, and quarks. In addition there was a series of

physics-and-society programs concerned with physics and the arms race, world problems, physics and the developing countries, lay concept of physics, and interdisciplinarity. All in all there was a rich garden of topics from which to choose.

The opening technical address was given by K. Hubner (Ebauches Electroniques S.S., Neuchatel, Switzerland) on "The Age of Silicon." He pointed out that the real impact of silicon technology lies in its widespread applications, such as dipolar or very complex MOS (metal oxide semiconductor) integrated circuits, large memories, high power devices, and optoelectronics including solar cells. Current development is concentrated on very large-scale integration with densities such that memories with one megabit per small silicon chip become a realistic objective. Hubner pointed out that the economic and social impact of silicon technology is comparable with the most important discoveries in history. These tiny silicon chips invade all sectors of our daily lives, be it at work, in transport, or at home. The consequences of the availability of cheap computer power and larger and larger memories are such that most industrial nations now sponsor important development and industrialization programs to maintain their position. The financial, technical, and commercial risks are enormous, but the stakes seem well worth the investment.

An illustration of the power of large computers was given by B.J. Mason (Director-General of the Meteorological Office, London) who described the development of a model of the world's climate. Starting with a uniform temperature earth and turning on the sun, he found that with this model the average climate of the earth appeared after a computer run corresponding to 100 days. The climate model is detailed enough to reproduce the rather complicated phenomena leading to the monsoons in India, for instance. Having established such a model, it can be used to predict what might happen if there were changes in the average intensity of sunlight falling on the earth, or if the CO_2 or ozone concentration of the atmosphere changed, or if portions of the African desert were to be irrigated. Fortunately, the predicted results seem not to be drastically sensitive to small variations in these parameters. However, the model is so complex that judgment and trained intuition are of little help in predicting changes. Mason illustrated this point by remarking that the very cold European winter a few years back seemed unaccompanied by any other anomalies except for an unexplained 2° rise in the average temperature of the South Atlantic Ocean. Sure enough, putting such a temperature change into the computer climate model resulted in a predicted severe European winter through interactions that are difficult to trace.

"Synchrotron Radiation and its Applications" was the topic discussed by S. Kapitza (Institute for Physical Problems, Acad. of Science, Moscow), son of the Soviet scientist who was recently awarded a Nobel prize in physics. Kapitza pointed out the explosive growth of this field in which the number of papers has been doubling each year. Synchrotron radiation is a powerful source of light, continuous in wavelength from the infrared to x-rays and with ever widening applications in physics, chemistry, and biology. It may become useful even in semiconductor technology in which masks can be reproduced with 0.1-μm resolution for high density integrated circuits. The Soviet effort in synchrotron radiation is strong. There are a number of sources at a variety of sites that match or surpass the best in the rest of Europe. All of the work on "wigglers" (a sudden change in path direction of the electron beam that enhances the emitted radiation) at this conference came from the USSR. However, the intensity of effort in synchrotron radiation is large throughout Europe; 36 papers on the subject were given at York.

In line with the interest of the EPS in paying more attention to the teaching of physics, R.G. Fuller (Univ. of Nebraska) was invited to talk on "Recent Developments in Physics Education." He reviewed briefly the work of Piaget in understanding the "Phases of Cognitive Development" beginning with the infant and proceeding to maturity. A problem in education at the college level—and among many adults—is that this development process may remain at the "Concrete Operational" level rather than proceeding to the final "Formal Operational" stage where reasoning using abstractions and generalizations occurs. Fuller managed to induce a great deal of audience participation in some simple problems and demon-

strations that emphasized the importance of abstractions, such as conservation laws or density, in physics problem solving. His message was that the teaching of physics could—if done with care—help students make this last transition in their cognitive development and could do it better than any other subject. Subsequent workshops and discussion sessions held with an enthusiastic group of teachers explored in greater detail ways and means of implementing these ideas into physics teaching and into the university curriculum.

The Cecil Powell Memorial Lecture was given by M.G.K. Menon (Tata Institute of Fundamental Research, Univ. of Bombay, India) on the subject of "Physics and the Developing Countries." Menon emphasized that there is no successful simple model for accelerating the progress of developing countries. A model that supplies capital and skills from the outside will fail unless the society is ready to receive the aid and have it act as a catalyst. Another model suggests that progress is based on science and technology so that purchase and importation of this technology is a solution. Menon argued that this has not worked and that the technology must be appropriate to the culture to which it is to be applied. The country itself must be capable of selection and application and therefore needs an indigenous source of science. Menon felt strongly that to make an advance the country must itself want it, plan it, and direct it. A local science educational establishment must exist and teach in its native language, otherwise science teaching is only memory training. Willingness to apply science to problems of the culture must be developed among scientists, and the financial system of the country must be geared to be able to respond to opportunities. This is about as specific as Menon feels one can be. Developed countries became so without a plan, and the kinetics of the process is not yet well enough understood to rely with much assurance on any single master plan.

In one of the closing lectures A. Zichichi, the current president of EPS (Geneva, Switzerland), talked on "New Developments in Elementary Particle Physics." His thesis was that there are six fundamental forces known so far in nature: Strong, semi-strong, electromagnetic, weak, superweak, and gravitational. He argued that an impressive series of experimental results support the Salam-Weinberg unified theory of weak and electromagnetic interactions. Furthermore, he felt that steady progress is being made in attempting to achieve a unification of all these forces of nature and that the great syntheses are no longer remote.

The conference, consisting of about 600 people, was held at the University of York, a new university started about 1960. It is on the outskirts of the ancient walled city of York with its Roman ruins and impressive cathedral. The university buildings with interconnecting covered walks (but no sides) are scattered around a small artificial lake. It is one of those successful architectural achievements in university creation that should be studied. The unity of design aided by the lake and fountain, the beauty of the walks and grounds aided by the British genius in landscape gardening and the willing cooperation of wild fowl, and the elegance of the solutions to the problems of a university in having a coherence of the whole along with a separateness and individuality of its parts, makes it one of the most memorable schools that I have visited. (Clifford C. Klick)

SIXTH INTERNATIONAL CONFERENCE ON RAMAN SPECTROSCOPY

The Raman effect is the inelastic scattering of light from molecules and is thus different from Rayleigh (molecular, elastic) scattering and Mie (particulate) scattering, although it is, of course, affected by scattered light intensity from particles when they are present in a medium under observation. The Raman process is essentially instantaneous, occurring within a time of 10^{-12} sec or less. Thermodynamic equilibrium is assumed in the system. At the time of the discovery of this effect by Chandrasekhara Venkata Raman in Calcutta, India, in 1928 (he was knighted in 1929 and received the Nobel Prize in physics in 1930), there was naturally considerable excitement about both the implications (the Born-Raman controversy) and the various applications of the effect.

In 1953, on the occasion of the Silver Jubilee of the discovery, Albert Einstein noted the implications in the following words: "I still vividly recall the deep impression of this discovery—that the energy of a photon can undergo a partial transformation within matter—made on all of us."

The Sixth International Conference on Raman Spectroscopy was held in Bangalore, India, 4-9 September 1978 in recognition of the 50th anniversary of the discovery of the Raman effect. After having made his discovery, Raman had established an Institute for research in Bangalore. The Conference was held at this site, at the invitation of Prof. S. Chandrasekhar who was responsible for the remarkably excellent arrangements. The International Organizing Committee and the Program Committee, with representatives from Canada, France, Germany, India, and the US were both chaired by Professor J.R. Durig (Univ. of South Carolina, Columbia) who leads an important group in this field. Durig also co-chaired the Conference with Dr. K.G.K. Menon, Scientific Advisor to the Indian Minister of Defense.

The importance attached to this Conference by the scientific community is clearly evident by the fact that it was co-sponsored (and often financially supported) by all concerned International Scientific Unions, e.g., the IUPAP, IUPS, and IUBS, and also by several scientific organizations in India. About 360 persons attended, of whom 250 came from outside India (US 45, France 45, Germany 15, and the remainder from about 15 other countries, including east-European ones) where experimental and theoretical studies related to Raman effect are being undertaken.

The technical program was arranged with each morning being devoted to invited lectures in plenary sessions and each afternoon to 4 specialist simultaneous sessions. Forty-five invited lectures and 250 contributed papers were presented in a total of 40 hours. In practically every case there was some formal discussion and, of course, considerable discussion followed in the beautiful lounges and gardens of the Ashoka Hotel where the Conference was held.

In the past 50 years, the Raman effect has been utilized in a variety of applications in chemistry, biochemistry and biology, gases and flames, and in such devices as for remote-sensing in the atmosphere. For example, the suggestion of a tunable magneto-Raman laser, using 10.6-μm CO_2 laser radiation as the pumping source, led to the development of a spin-flip Raman laser that has found application in the study of semiconductors and in optoacoustic spectroscopy which itself has been applied in such diverse situations as the detection of NO and H_2O in the stratosphere and isotope separation, the subject of which was C.K.N. Patel's (Bell Laboratories, Murray Hill, NJ) contribution at the Conference.

Developments in Raman spectroscopy have naturally taken giant steps with developments in lasers and data acquisition and processing. The enormous possibilities with lasers have also created a demand for high-repetition-rate pulsed lasers as well as high-power CW lasers, not to mention ingenious ideas in the use of existing lasers. While interference filters are unlikely to be discarded, there are important developments in the use of low-light-level multi-channel detectors for data acquisition and processing. Eventually single electron-photon sensitivity may become commonly feasible for pulsed devices.

While major developments until recently have been in linear, inelastic scattering processes, there is considerable excitement now with developments in a variety of nonlinear optical processes, and N. Bloembergen of Harvard, S. Brodersen of Aarhus Univ., Denmark, and A. Lau (Akademie der Wissenchaft in der DDR & Spektraskopia, Berlin, DDR) discussed the enormous possibilities in the next decade for the understanding, development, and application of various nonlinear Raman processes, in particular coherent anti-Stokes (CARS) and Stokes (CSRS) Raman scattering with resonant enhancement. Interesting theoretical developments are also occurring in regard to these techniques, and it is important to realize that fundamental phenomenological questions still exist. For example, the nature of changes in scattered light during resonance, and its relation to luminescence, as described by L. Rebane (Institute of Physics, Estonian SSR Academy of Sciences, Tartu, USSR), A. Nitzan (Northwestern Univ. IL), Bist (Nainital, India, an important center in India for research other than Bangalore); and H. Baranskaya (Institute of Industrial Chemistry, Warsaw, Poland).

One can also foresee some developments in stimulated Raman scattering.

Papers were also presented on hyper-Raman scattering (which is a three-photon resonance process), notably from France (XF. studies), Japan, and the UK.

The CARS technique and stimulated Raman spectroscopy are considered very powerful tools in high-resolution spectroscopy, and interesting results can be expected around the world in the near future. The high-resolution work at München and Bayreuth in the FRG reported was particularly interesting.

Micro-analysis by Raman spectroscopy (Raman microprobe/microscope is now commercially available) holds considerable promise for various applications including biology and outer-space studies. The developments reported from LASIR (Laboratoire de Spectrochemie Infrarouge et Raman) in Villeneuve d'Ascq, France, were noteworthy in relation to similar studies at the NBS in Washington, DC.

Raman spectroscopy of certain metallocarbyne complexes and adsorbed species on solid surfaces was also discussed. Some exciting developments were reported from Garching in the FRG, Nishinomia and Tokyo in Japan and New Castle, Australia. The angular distribution of fluorescence and Raman intensity from small particles (1-10 μm) is required in Raman microprobes to convert intensity to molecular concentrations contained within aerosols. Preliminary work reported from Yale University seems promising.

In the study of crystals using resonance Raman techniques, an important application is of course to semiconductors. Recent developments in the use of resonant phonon-Raman scattering at Aachen, FRG, are noteworthy in this respect.

Among chemical applications, two examples of the adoption of several techniques in combination were described by Dr. and Mrs. I.R. Beattie (Univ. of Southampton, UK) and Bist. The first related to establishing the characteristics of high temperature vapors (many inorganic compounds are involatile at normal temperatures and pressures, and the problem concerns the study of such species as discrete manomers) by matrix isolation, infrared and Raman spectroscopy together with mass spectrometry. Gas phase Raman and CARS spectroscopy on high temperature systems are valuable for *in-situ* studies of molecules both in equilibrium and in dissociation. Bist's second contribution related to the determination of ground state assignments and information on excited states of rather large molecules e.g., phenol, pyridine N-oxide. Taking advantage of symmetry in such molecules, Bist demonstrated how by a combination of microwave, IR, Raman and electronic spectral studies (including fluorescence and resonance fluorescence), details on various states could be obtained.

An attempt at reconstructing a three-dimensional object image by interference pattern using stimulated Raman scattering in liquid nitrogen, acetone, etc., was described by A.I. Sokolovskaya (Lebedev Physics Institute, USSR). Image reconstruction seems to obey the laws of hologram reconstruction.

In the study of biological materials, the principal problem is the interpretation of spectra obtained from various types of resonant Raman studies. Consider a naturally occurring chromophore such as a visual pigment whose biological functions are known to depend upon the electronic states of the pigment. The kind of information that a biochemist needs pertains to a model for the chromophore in terms of its chemical conformation and its interaction with the biological matrix and a method of following changes in chemical conformation with significant biochemical changes in the system. Unfortunately not all biological systems provide resonance Raman spectra. It is proposed to adopt the method of "vectors" wherein simple resonance Raman labels are introduced into the system for "mimicking" and "reporting." Important medical applications of these techniques were presented by researchers from the University of Erlangen-Nürnberg, FRG.

The study of large molecules (e.g., large organic molecular crystals) is also of interest in the case of natural and synthetic fibers. Again, one is interested in building models that can adequately simulate changes in organic molecular solids, as described by L. Colombo (Institut "Rudjer-Bŏskovfc", Zagreb, Yugoslavia).

An interesting application of Raman techniques to chemical and biochemical systems, carried out by the Institut de Médecine Légale, Lille, France, related to fingerprinting illicit tranquilizers (or bad curries!).

Among various practical applications of Raman spectroscopy are the study of flames—temperature, concentration of species, and general structure of flame. While practical flames in engines, boilers, and plumes are generally turbulent and sooty, ingenious methods are being devised to apply both normal spontaneous Raman scattering techniques as well as CARS to laboratory-type but fairly complex situations. Attempts are also underway to obtain overall structure of turbulent flames by using multi-channeling techniques expected to yield multi-dimensional Ramanographs. Such information (along with fluorescence data) may prove valuable in the future. Other than the need for better lasers and optical data acquisition systems, important fundamental questions remain. Probe volume, signal averaging, linewidth correspondence and nonintrusiveness are also not unambiguous. Anyone entering this aspect of the Raman field needs to be cautioned of the enormous outlays involved in obtaining even moderately useful and statistically-trustworthy data.

From the contributed papers, it is clear that very many physics research centers have a group interested in Raman spectroscopy. The striking feature is the vigor, elegance, and substance of researches based essentially on this one effect in so many diverse fields. The printed proceedings distributed at the Conference (950 pages!) alone do not convey the excitement of the workers in this field. Each molecule, each aerosol, and each biological substance affects a photon specifically, if at all, and there is no apparent end to the joy of catching it and finding out what happened to it in transit.

The Seventh Conference may be held in the USSR in 1980. (S.N.B. Murthy, Purdue University, West Lafayette, IN)

THE HIGH MAGNETIC FIELD FACILITY IN GRENOBLE

In the years since WWII Grenoble has become a scientific center known throughout the world. This development sprang largely from the war time dislocations that led Prof. L. Néel to come to this small attractive city nestled against the foothills of the Alps. From 1945 on he was a professor at the Faculty of Sciences of the University. He added to his duties by becoming Director of the Polytechnic Institute in 1954 and also Director of the Center for Nuclear Studies in 1957. With all of this, he has also produced a rich harvest of research work that is central to the more modern understanding of ferromagnetism and antiferromagnetism. His influence is seen everywhere in Grenoble: the bright new university campus has research groups that are active in magnetism; coupling between the University and the Polytechnic Institute is common and easy—and unusual in Europe; and a large nuclear research establishment has grown up in Grenoble, where an international facility has been built, which is one of the most powerful sources of slow neutrons for diffraction studies of solids.

My particular interest was to visit still another international laboratory related to Néel's interests: the high magnetic-field facility called, in French, the "Service National des Champs Intenses" and, in German, the "Hochfeld-Magnetlabor." The decision to establish a large magnet of the Bitter design was taken in 1965 with a target of developing a 20-T (200 kG) field over a volume 5 cm in diameter. In 1972 the West German Max-Planck-Institute for Solid State Research joined the French National Center for Scientific Research (CNRS) in a 10-year contract to support the high magnetic field facility. It is thoroughly bi-national. There are two directors: R. Panthenet for the French and K. Dransfeld for the Germans; the annual report is printed with parallel columns of French and German.

The main Bitter magnets operate from a series of generators that can be combined to give a total electrical power of 10 MW. There are 2 magnets that will produce 20 T with this power. At lower powers there are 5 magnets that operate up to 15 T and, because of their lower powers, several of these can operate simultaneously. The magnetic field stability is good: 10^{-5} over a period of 2 hours and 10^{-6} for 10 minutes. A special proton resonance sensor has been set up with feedback loops to hold the field steady to 10^{-8} at 11 T if needed. In addition there are magnets designed especially for Mössbauer and optical studies with the optical beam entering horizontally into the center of the magnet instead of the more

usual vertical access. There are also superconducting magnets. All of the magnets can be used with low-temperature Dewars for measurements down to liquid helium temperatures. There is a helium dilution refrigerator for measurements down to 30 mK. High pressure facilities also exist for use with the large magnets. One can get hydrostatic pressure up to 14 kbar, quasi hydrostatic pressure to 60 kbar, and diamond cell pressure to 150 kbar.

The magnets are very heavily used and scheduling is currently done 3 months in advance. About 45% of the use is by French scientists most of whom are resident in the Grenoble area and are interested in magnetism. Another 35% of the use is by a resident group of 10 German physicists whose main interest is semiconductors. The remaining 20% of usage is by visitors from all of Europe with a great variety of problems involving superconductors, atomic and molecular spectra, large molecules and liquid crystals, and biological and chemical activities in magnetic fields.

Panthenet and his group are already looking forward to a 1982-1992 contract which they hope will involve support not only from the present sponsors but also from a German nuclear research institute in Karlsruhe. They intend to build a magnet capable of operating at 30 T over a 5-cm-diam. volume, the design of which involves the creation of a series of concentric magnets. On the outside would be a NbTi superconducting magnet and next a Nb_3Sn superconducting magnet that can operate at higher fields. Together, these magnets would produce 13 T. Inside the superconducting magnets, the group plans to build resistive magnets operating from the 10-MW generator that will give another 17 T for an overall total of 30 T. The problem is always how to design magnets that are mechanically sturdy enough—and safe—so that conductors carrying large currents in a high magnetic field will not be destroyed. In the Bitter magnet design the current flows down in a helix fashion through a series of water-cooled flat plates separated by thin insulators. A maximum force is felt at the center of this stack of plates. The Grenoble group believes that a better design can come from a series of concentric helices. These can be built and powered so that the stress on the windings is uniform throughout the magnet. If the experiments here and at other magnet laboratories prove successful, this new design may be used in the Grenoble 30-T magnet.

For magnetic fields above 20 T, the group is now using a pulsed field involving condensor discharge through a coil. They reach 40 T with a pulse that has a sinusoidal shape and a width at half maximum of about 1 msec. At Toulouse there is a long pulse magnet also with a maximum of 40 T but with a pulse length of 100 msec. The Grenoble group hopes to improve its pulsed magnet facilities as part of its future expansion.

All in all the Grenoble high magnetic field facility is a well-organized and very busy establishment, that seems to be successful both in seeing that a large variety of experiments are handled with efficiency and in continually updating the excellent resources that it makes available. (Clifford C. Klick)

LASER INDUCED PROCESSES IN MOLECULES—EDINBURGH

A conference entitled Physics and Chemistry of Laser Induced Processes in Molecules was held at Heriot-Watt University, Edinburgh, Scotland, 20-22 September, 1978. The choice of Heriot-Watt was appropriate for this subject matter as the Physics Department is actively engaged in research on that topic (See *ESN* 32-4:145). Approximately 100 papers were presented by authors from the US, FRG, France, UK, Canada, USSR, Israel, Italy, Iraq, and Belgium, including 21 papers given in a poster session. The topics discussed included: Spectroscopy and diagnostics of laser-induced processes, new lasers, multiple photon excitation and vibrational photochemistry, and the chemistry and relaxation processes of excited states. The organizers are to be congratulated on the whole for a well-planned conference.

R.M. Osgood (MIT, US) described his work on photoassociating Hg with an ArF excimer laser to form vibronically-excited Hg_2 exciplexes with vibronic levels near $v = 57$. Analysis of the radiation from these associated molecules shows a well-defined oscillatory spectrum which provides information on the intramolecular potentials of excited and ground states. Additionally photo-

association may be used to produce tunable uv lasers in the 2000-2400-Å region.

The study of polyatomic molecules by looking at their vibrational spectra is not easy because the vibrational relaxations are extremely fast. Several papers discussed special techniques for looking at ultrafast relaxations from these molecules. S. Schneider et al., (Technische Universität, Munich, FRG) described their work with two flashlamp-pumped dye lasers. The two lasers are synchronously mode-locked and produce trains of pulses of about 5-psec duration. The output of the first laser actively mode-locks the second laser by bleaching a saturable absorber in the cavity of the second one. This second laser has a cavity length slightly different from the first. During one laser shot two pulse trains are produced with a continually increasing delay between successive pulses. The pulse train from the first laser is used to bleach the sample repeatedly. The second laser is used as a probe to measure the transmission at various delay times. In this way the time-resolved relaxation of the sample can be studied during one laser shot with a time resolution in the psec range.

The subject of ir multiple photon dissociation of molecules was discussed by several authors. It is still not a completely understood process, but more information has been obtained recently. G. Hancock (Physical Chemistry Laboratory Univ. of Oxford, UK) has been studying the dissociation of CH_3NH_2 and NH_3 with radiation from a CO_2 laser. A wavelength in the range 9.46 to 9.70 μm was used for CH_3NH_2 dissociation. The yield of dissociated products from both molecules showed a cubic dependence on fluence, ϕ (accumulative energy per unit area), for fluence values in the range 15 to 35 J/cm^2 and a $\phi^{4.5}$ dependence at lower ϕ values. Time dependence studies of the dissociation yield with 10-nsec resolution were consistent with a dependence on fluence at high fluence values, >15 J/cm^2, but not at lower values. The dissociation mechanism is not clear yet; a better model, perhaps one which depends on intensity as well as fluence, must be developed.

The problem of multiphoton excitation in SF_6 was reviewed in invited papers by C.D. Cantrell (Los Alamos Scientific Laboratory, NM,) and by N. Bloembergen (Harvard Univ., Cambridge MA). The lack of a good theoretical model that explains observations is apparent from these and other talks. More excitation measurements with wide-band tunable lasers must be carried out at different intensities and fluences.

R. Wallenstein and H. Zacharias (Fakultät für Physik, Universität Bielefeld, FRG) have demonstrated, for the first time, that light from frequency-doubled lasers can be used to perform high-resolution, three-photon absorption measurements of atomic and molecular states. High resolution is achieved by simultaneous absorption of two visible photons arriving from the same direction and a single uv photon arriving from the opposite direction. Doppler broadening is greatly diminished in this scheme. The authors successfully used this method to excite the 8^1P_1 state of Hg.

Broadly tunable lasers are necessary to carry out spectroscopic measurements. The uv region is especially in need of such sources. V. Wilke and W. Schmidt (Universität Essen, Essen, FRG) have obtained dye-laser-pumped stimulated Raman scattering (SRS) in high pressure H_2 over the spectral range 1850 to 8800 Å. The dye laser was pumped by a frequency-doubled Nd:YAG laser.

Biological applications of lasers are receiving much attention. A. Anders (Fakultät für Physik der Universität Bielefeld, FRG) described the use of various frequency-doubled, narrow-band dye lasers operating in the spectral range 2180 to 3200 Å. Available sources in this region have made it possible to excite single kinds of DNA lasers selectively. Anders has been making studies on various DNA-dye-complexes. The purpose of these investigations is to obtain information on energy transfer mechanisms and molecular structure of these complexes.

A. Ben-Shaul and O. Kafri (Hebrew University, Jerusalem, Israel) have developed a theoretical model to explain the mechanisms in a pulsed, HF chemical laser utilizing the reaction, $F + H_2 \rightarrow HF + H$. They used a thermodynamic description that discards the restriction of rotational equilibrium of previous models. This picture explains the relatively high efficiency of the HF chemical laser.

The new field of matrix spectroscopy greatly simplifies certain photochemical reactions. In this method the substance

under investigation is frozen in solid Xe or another inert gas. When irradiated, the reactants are trapped in the solid and can be examined over an extended period of time. Other advantages include: No rotation, no hot bands, very sharp spectra, and no thermal reactions, as kT is extremely small. Disadvantages include the presence of phonon modes and photofragments which cannot be removed for chemical or other analysis.

Interest in photomolecular interactions has grown greatly in the last few years. As evidenced by this Conference, the activity covers a much broader range of topics than just isotope separation and chemical lasers. It will be especially interesting to follow during the next few years the progress of theoretical and experimental work in the area of multi-photon molecular excitation. (Vern N. Smiley)

MICROWAVES—NEW TOOLS FOR THE MEDIC?

If we consider that a photograph of a human body is really a map of its surface features, then there are at least two different types of such maps possible. The first is the conventional photograph. There the body is illuminated so that the photograph is a map of the relative amounts by which light is scattered from the surface into the camera. The second one, which is not generally within our experience, uses no external illumination but depends on the fact that any object whose temperature is above absolute zero emits electromagnetic radiation of a degree whose intensity (and spectral distribution) depends on the temperature and emissivity of the surface. In principle, to take a photograph of this type, one would put the subject into a dark room, preferably with cold walls, aim the camera as usual and expose the film. The "photograph" resulting would look quite different from the conventional one. Instead of picturing local light-scattering characteristics it would be a temperature, or radiometric map of the body surface. Of course, since such a photograph would have no esthetic value, it never appears in anyone's picture album.

However, a radiometric picture can have medical value. In fact, in recent years there has been much work aimed at the detection of tumors by radiometry, for it is known that a region of the body whose blood supply is blocked by a tumor has a slightly higher temperature than normal regions. Instead of the use of visible-light temperature mapping, however, one uses infrared (ir), where the energy emitted is ever so much greater.

Even ir has a drawback, however. It penetrates only very slightly into the human body, so that, in accordance with a reciprocity principle, the temperature mapped is that very near the skin, and most of the information relating to possible tumors deeper within the body is lost. Since microwaves penetrate much deeper into the body than ir—a fact utilized by the microwave cooking industry—perhaps they can map those deep tumors.

This subject of Microwave Radiometry, or Thermography, was an important portion of a one-day workshop on Diagnosis and Therapy using Microwaves, held in Paris on 8 September 1978. Coordinators were Dr. Michel Gautherie (Université de Strasbourg, Faculté de Médécine, 11 Rue Humann, 67085 Strasbourg Cedex) and Dr. A. Priou [ONERA - CERT, Microwave Department (DERMO), BP 4025, 31055 Toulouse Cedex].

In addition to papers dealing with this new technique of noninvasive medical diagnostics, the use of microwave radiation for therapeutic heating and hyperthermic treatment of tumors and the influence of microwaves on some biological systems were also discussed. The workshop was jointly sponsored by the International Microwave Power Institute, the World Health Organization's (WHO) Regional Office for Europe, the Biomedical Section of the French Electrical Electronics Engineers, the Engineering and Biomedical Group of the French General Delegation to the Technical and Scientific Research Group, and the French Health Organization. WHO was represented by Dr. M. Suess, who delivered the official welcome greeting.

In addition to this greeting, Suess mentioned the interesting fact that WHO is currently preparing a handbook on the Public Health aspects of nonionizing radiation. Prof. Michaelson (Univ. of Rochester Medical School, NY) is responsible for the microwave portion.

In the first session, entitled "Thermography, Radiometry," two groups from the US who have been pioneering in microwave diagnosis discussed their work. Prof. J. Edrich (Univ. of

Colorado and Univ. of Denver) has been scanning portions of the human body by the radiometric technique for emission in the millimeter wave range (say, 60 GHz, or wavelength λ of 5 mm). In his system the radiation from a spot of approximate dimension $\lambda/3 \times \lambda/3$, as determined by diffraction limiting, is picked up by a 2-ft-diam. horn, to be detected by a microwave receiver. A composite radiometric picture is formed by mechanical motion of the horn and appropriate image processing.

Edrich stated that an optimum frequency range for microwave medical radiometry has not yet been determined. Low frequencies achieve a greater depth of penetration but at a sacrifice of resolution. Thus, the skin depth of ir, with it's excellent resolution, is only a few microns, while 50-GHz waves have penetration depths of around 0.2 mm. While even this distance is very small, it has been found that lymph node tumors that went undetected with ir were detected with millimeter waves.

Edrich mentioned that in addition to using microwaves for tumor detection they could also be used for identification of abnormalities arising from arthritis and other diseases. Quite possibly, however, an important application would be in tumor screening tests, with suspicious cases to be followed by x-ray examination.

A similar view was held by P. C. Myers, who, together with N.L. Sadowsky and A.H. Barrett, has been doing 1.3-, 3.3-, and 6.0-GHz body radiometry at MIT and Faulkner Hospital, Boston. Myers was of the opinion that the depth of penetration is more important than high resolution. In his experiments, carefully matched waveguide antennas loaded with dielectric (to reduce size) directly contacted the skin. Bandwidths used varied from around 100 to 500 MHz. Excess temperature differences sensed in this tumor detection technique varied from zero to 4°C. To-date the group has examined over 4000 women in a breast cancer detection unit, with correlations between microwave radiometric results, clinical examinations, x-ray mammography, infrared radiometry, and biopsies. Typical microwave breast cancer detection rates were: True positive, 70%; true negative, 70%. When ir and microwaves were used together, true positive rates of 90% resulted. This suggests a combination of both techniques as part of a first-pass, no-risk screening.

One problem in radiometry is that the energy emitted from a surface depends not only on the surface temperature but also on the emissivity. This emissivity factor, which for the human body was said to vary from 70% to 100%, can be determined separately by measuring the absorptivity, i.e., the fraction of incident power (from an outside source) that is absorbed by the surface, because for an isotropic medium the absorptivity equals the emissivity. K.M. Lüdeke et al., (Philips Laboratories, Hamburg) described an instrument that uses this technique for automatic measurement of surface temperature.

J. Robert et al., (Nancy-Strasbourg, France) described microwave radiometric work with 30 patients that verified essentially what Edrich and Myers had stated. The frequencies were 30 and 68 GHz—the range used by Edrich, who spent a large portion of this past year as a member of Robert's group.

In a paper by D.D. N'Guyen et al. and delivered by Y. Leroy (Lille, France), radiometric thermography at x-band was described. In addition, Leroy suggested that sensitivity of tumor detection could possibly be increased over current techniques by use of a heating cycle before the measurement cycle. One would expect tumors to heat up at a higher rate than normal tissue, so that the temperature differential would be greater.

A paper that was to discuss the interesting feature of microwave Doppler radar in medical diagnosis and three in the following session that were to deal with microwave heating were cancelled (including a paper from Saudi Arabia). In that session, entitled "Generators, Applicators, Models," J.W. Hand et al. (Cyclotron Unit, Hammersmith Hospital, London) discussed the heating of small amounts of tissue and showed that when such tissue samples are heated by microwaves they undergo a more uniform treatment than by other methods. H.G. Klinger (Würzburg, FRG) in a theoretical paper, discussed a method of characterizing *in vivo* heating by experiments of *in vitro* heating. R. Zimmer et al. (Strasbourg, France) using the approximation of ellipsoidally shaped tumors, discussed his Laplace equation solution to arrive at thermal distribution in the body for various time intervals of 2450-MHz heating.

In a session dealing with biological investigations, K.S. Zärker et al.

(Munich) discussed a biophysical-chemical analysis of cultured glioma cells irradiated with microwaves, while the program portion dealing with clinical investigations contained a paper by J. Holt (Leedeville, Australia) on abnormal metabolism of cancer cells, as revealed by their response to 434-MHz radiation. D. Gericke et al. (Frankfurt, FRG) reported on "progress of oncolysis due to apathogenic clostridia."

More easily followed by the majority of participants, who were microwave engineers, were reports of clinical investigations or of the tools used in these. For example, F. Sterzer (RCA) discussed research carried out jointly by RCA and Montefiore Hospital, New York, on the treatment of lesions by hyperthermia combined with radiotherapy. For small lesions, irradiation was through a dielectrically loaded waveguide next to the skin; for large lesions a printed circuit antenna of beam dimensions 10 cm × 10 cm was used. For treatment of the prostate, hyperthermia was induced by microwaves from a coaxial probe, inserted in the rectum. Where comparisons were possible, the faster disappearance of the lesion was with treatment through hyperthermia only.

O. Petrocsicz et al. (Institute for Experimental Surgery, Technical Univ. of Munich, FRG) reported on the technique of work in Munich aimed at the treatment of prostate tumors by localized microwave heating through rectal insertion of a heating probe in mature dogs. Design considerations for such a probe are interesting. German regulations limit diathermy sources to either 433.9 MHz or 2.45 GHz. Since the dielectric constant ε_r of tissue at these frequencies is 75 and 49, respectively, with corresponding penetration depths of 3.6 and 1.7 cm, and since standing waves possibly associated with electrically long line lengths were to be avoided, 433.9 MHz was selected. To conform with body structure and to effect heating in only one direction, a cylindrical slot antenna was chosen. The additional requirement of maximum heating at 10-15 mm from the probe resulted in the antenna being inserted into a cooling water bath, all within the probe walls of approximately 20 mm o.d. (these walls were, of course, transparent to the microwaves). The water ($\varepsilon_r \approx 80$) had the additional advantage of providing a near electrical match to the tissue. Tests of this microwave heating system in a simulated environment have resulted in a 4°C rise at a distance of 10-15 mm external to the probe after 10 minutes of exposure to 20 W of rf power, with negligible temperature rise at the probe itself.

The "heating at a distance" was also discussed by E.B. Douple et al. (Hanover, NH), who discussed work in progress on hyperthermia with microwave invasive systems. These investigators are designing miniature radiators of the size of gamma ray probes as catheter antennas or probe antennas for treatment of brain tumors. They suggested that this therapy should probably be combined with that involving ionizing radiation.

This double-therapy approach, in fact, was the theme of some very encouraging results reported by V. Hymen and C. Wieland (Heidelberg, FRG), who have been combining 433.9 hyperthermia with megavolt x-ray treatments on human patients with radio-resistant malignant tumors. In their work the tumor temperature was raised to 42°C during irradiation by microwaves. The effects were significant in that 72% of the more than 40 patients treated responded favorably, without noticeable side effects—quite an encouraging result.

In summary, this workshop demonstrated that microwaves may well add to modern medicine's bag of tricks, both as a diagnostic as well as a therapeutic tool. It is comforting to know that another use of benefit to mankind has been found for a technical field that was developed originally as a tool of war.

Individuals interested in details of the papers presented in the workshop may find these in a special issue of the *Journal of Microwave Power* to be published in early 1979. (Irving Kaufman)

ONRL REPORTS

See the back of this issue for abstracts of current reports.

PSYCHOLOGICAL SCIENCES

PSYCHOLOGICAL RESEARCH ON EYEWITNESS IDENTIFICATION

In response to wrongful convictions, the British Home Secretary in 1974 appointed Lord Devlin to chair a committee on eyewitness identification and the law. A review of such procedures is not ill-placed because courtroom justice in criminal proceedings is fundamentally based on identification. The assumption is that the human observer is a video and an audio recorder that sees and hears accurately, and will so testify. If the witness distorts the testimony, direct and cross-examination will set it straight. In the report of the Devlin committee (*Report to the Secretary of State for the Home Department of the Departmental Committee on Evidence of Identification*, Her Majesty's Stationery Office, London, 1976), psychologists were needled by the observation that a gap existed between academic research on eyewitness identification and the practical requirements of courts of law. B. Clifford and R. Bull (both of North East London Polytechnic, London) reacted vigorously to the stimulus with an article (*New Scientist* 70, 307-308, 1976) that said that the Devlin committee ignored most of the pertinent psychological research and did a poor scholarly job. They followed this up by writing a book (*The Psychology of Person Identification*, London: Routledge & Kegan Paul, 1978) that lays out psychological research on eyewitnessing for Devlin and everyone else to see. Clifford and Bull also have been on the lecture circuit with recent appearances at major meetings. They were on hand at Oxford University for a conference on psychology and law, 26-28 September 1978, sponsored by Oxford's Center for Socio-Legal Studies and the Social Sciences Research Council (for a report of this conference, see *ESN* 32-12:437). And, they both appeared on a symposium on eyewitnessing at a conference on the practical aspects of memory, sponsored by University College of Swansea and held at the University of Wales Institute of Science and Technology, Cardiff, 4-8 September 1978 (for other aspects of the conference, see *ESN* 32-12:435). Clifford and Bull may be the UK's most energetic psychologists working on eyewitness identification, but they are hardly alone. Other British psychologists also have a lively interest in it. In the US, E. Loftus (Univ. of Washington, Seattle) has generated visible research in this area.

First, Clifford & Bull's book. Certainly it is the best source for anyone interested in psychology's contribution to the understanding of eyewitnessing. It emphasizes that eyewitness identification is an old research interest of psychology and that we are not very good at eyewitnessing the events of a real-life situation, such as a crime. It is true that recognition of the picture seen today will be high tomorrow, but it is not necessarily true that identification of the hit-and-run driver who ran the stop sign and struck down the child will be high. To illustrate the poorness of human eyewitnessing, the book reviews a research study that staged an assault by a student on a professor in front of 141 eyewitnesses. In a test 7 weeks later, only 40% of the witnesses correctly identified a photograph of the assailant and 25% picked the wrong man (an alarming thing about the book is evidence of relatively high false-positive rates where witnesses finger an innocent). They devote much of the book to research on why eyewitness identification of real-life events is poor—imperfect reception of information, biases that shape perception in the direction of what is believed rather than what is veridical, the unwitting fabrication of details that memory fails to provide, the effect of verbal labeling on perception, the design and composition of the lineup, the biasing influences of the police, and so on.

In the symposium on eyewitnessing at Cardiff, Clifford, in an apparent concession to Devlin, said that identification research does not attain the standards of realism that the law requires. Needed is a live to-be-remembered incident with a live test of identification like a police lineup, or a live presentation followed by a representational test with photographs. Too often, psychologists in their research use an unrealistic combination like a photograph as the incident to be remembered and photographs in the test, which is viewed with scepticism by law enforcement officials. Research paradigms must be used that generalize,

Clifford said. On the same panel, almost in response to his plea, was K. Patterson (Applied Psychology Unit, Medical Research Council, Cambridge, UK) who evaluated the format of presentation and test. She had all combinations of representation (photographs) and "live" (film) for presentation and test. (The film for simulating live conditions is not quite what Clifford had in mind, but nevertheless the experiment does say something about change in format from presentation to test, which is of interest and of some practical value.) The critical thing, Patterson found, was that best identification occurs when the format is left unchanged. Whether photographs or films, correct identification hovered around 86% when the format was unchanged. Change the format and correct identification dropped to about 50%. Insofar as one can generalize from these data to the real world, the message is: A crime is committed by live people, so whenever possible use a lineup with live people, not photographs, as the identification test. But a decision to rely on the lineup can create more problems than it solves. Who should be in the lineups, what should they look like, how many lineups to have in the test, and the possibility of the police, unwittingly or otherwise, biasing the witness, are among the problems that psychology has scarcely touched and of which the law may be only slightly aware. (Jack A. Adams)

SPACE SCIENCES

A EUROPEAN LIDAR FACILITY FOR SPACELAB

The European Space Agency (ESA) has been investigating the various aspects of incorporating a lidar (light detection and ranging) facility aboard Spacelab since 1973. The lidar technique consists basically of stimulating a target by use of a relatively high-powered laser (1-5 kW) and optically observing the resulting effects via a receiving telescope and optical detectors. A Phase A definition study was completed in mid-1976 on a Spacelab-borne lidar involving the scientific aspects of such a facility and a technical description of the system. At the end of 1976, the Director General of ESA appointed a team consisting of scientists and engineers from France, England, Germany, and Italy to review this definition study and define a baseline for a follow-on mission model study to be completed in mid-1978. As a result of this review, the Lidar Facility Team has identified four basic missions, the first two being devoted to atmospheric research and the third and fourth to geodesy and oceanography. The proposed experiments in the first category include determinations of aerosol, minor components, wind velocity, and temperature profiles. Many of these determinations are also possible with passive sounding techniques but with different accuracies and sensitivities, the major lidar contribution being high altitude definition in the profiles. The experiments in the second category include sea wave altitude distribution, altimetry of the earth's surface, and gravitational experiments in connection with sub-satellites. These experiments are intrinsically impossible by passive methods as the measurement of a distance with high accuracy by measuring the transit time of photons is possible only by lidar techniques.

The first mission model envisaged by ESA would investigate aerosols, clouds, sodium distribution, sea wave profiles, and Spacelab altitude. In this instance the telescope would be rigidly fixed to a Spacelab pallet element and the laser electrical power limited to 1.0 kW. Aerosols in the troposphere and stratosphere would be investigated. In the case of tropospherical aerosols it is common to discern between four types—sea salt, continental, mineral dust, and background. The first, sea salt aerosol, is produced at the surface of oceans, and its concentration is strongly dependent on wind velocity. Its lifetime is relatively short, since most of it is removed by rainout or sedimentation over the ocean and it does not reach altitudes higher than 3 km. Continental aerosol originates primarily from the conversion of sulfur dioxide, nitrogenic and organic compounds into particulate matter. The gases are of natural and anthropogenic origin (industrial processes, volcanic activity, forest fires, and burning generally), and the resulting aerosol is concentrated in the lower 5.0 km of the atmosphere. Mineral dust is a type of aerosol originating pri-

marily from the arid zones of the earth such as transportation of dust from the Sahara Desert over thousands of kilometers. Background aerosol originates principally from mineral dust and continental aerosol, and consists of very fine material remaining after the filtering processes of clouds and rainout and is the main aerosol in the upper troposphere. It is anticipated that lidar returns would be correlated with *in situ* measurements (ground based and airborne) at different angular points for a better distinction between different aerosol regimes of particle size, number density, and optical properties. Stratospheric aerosol is thought to be formed by the oxidation of SO_2 and SO_4. The transport of SO_2 into the stratosphere is caused either by upward diffusion of tropospheric SO_2 or by injection by volcanic events of SO_2 and H_2S which is oxidized to SO_2. The chemical lifetime of SO_2 in the stratosphere is on the order of 3 years, a lifetime which explains the time constant of concentration decrease in periods of low volcanic activity. This time constant and the transport mechanism of stratospheric aerosol would be determined by lidar techniques.

The lidar would be used to give the topside height of clouds that is of interest in better understanding of atmospheric circulation and cloud motion especially for the cloud duster systems in the tropics. In the case of thin clouds, it will be possible to measure their lower boundaries and optical depth. Moreover, lidar is able to detect optically very thin cirrus clouds that otherwise would be invisible. Since the backscattered cloud signals are high, it is possible to spread the laser beam with a cylindrical lens in a direction perpendicular to the orbit of the spacelab and thereby via the proper detector system to provide a three-dimensional map of the cloud topside.

The vertical and horizontal distribution of mesospheric alkalis and metals can be studied by lidar, whereas passive techniques provide only total content. Measurements of these species will assist in understanding their origin and provide accesses to atmospheric parameters when used as tracers of the thermal or dynamic behavior of the atmosphere. In the first mission model the density and vertical distribution of the sodium layer will be observed. It is currently believed that the vertical distribution of sodium extends over 1.0 km and that this layer is stratified into 2 or 3 sub-layers, the evolution of which as a function of time is strongly related to the dynamic behavior of the atmosphere. Studies of this layering could result in a good deal of geophysical information including its global variation and origin. Similiar measurements would be extended to other metals and alkalis including those injected into the atmosphere as tracers of various physical processes.

The use of a laser as an altimeter instead of microwaves (radar) offers very high spatial resolution even at the greatest ranges. As the ocean mean level represents a good approximation of an equipotential surface, laser altimetry of the Spacelab over the ocean is a simple but effective manner in which to map the geoid directly. In particular, it will permit straightforward measurement of the relatively short wavelength gravity anomalies that are known or suspected to occur. A better understanding of the geoid is also important for a better comprehension of the dynamics of the lithosphere along the ocean ridges and in the continental margins.

The lidar system is also designed to utilize the high spatial resolution of the laser without any requirement for vertical stabilization to determine the profile of the sea surface with an accuracy of greater than 0.5 m. The sea topography (difference between the mean sea level and the instantaneous sea level) can be divided into three parts: The static or quasi-stationary phenomena originating in geostrophic currents (maximum height 2 m, width 2 km), and the difference in salinity effects; tide effects in open oceans (height 0.5 m, period 12 h); and short period phenomena such as wind waves, swells, and tsunamis. For the first two situations, the lidar technique alone will provide global coverage of the permanent state of the ocean surface and, for the third, it will complement other techniques such as active and passive microwave techniques using synthetic aperture radar, scatterometers, and radiometers. In addition, the laser method has the unique capability of detecting single events such as solitary waves.

The second mission model includes investigations with high vertical resolution of the ozone distribution in the stratosphere; of the concentration of

minor constituents of the stratosphere and troposphere; of plasma and neutral dynamics between the E and F layers with an emphasis on understanding plasma irregularities that produce radio scintillations; of temperature profiles between 80 and 100 km; and of the behavior of atmospheric winds.

Mission model 3 calls for the use of the lidar to range simultaneously at a number of earth sites materialized by retro reflectors. This experiment will permit the location of cube corners with respect to each other with a few centimeters accuracy. The results of the measurements will be of interest for geodynamical studies such as relative plate motions and fault creeping. Depending on the Spacelab altitude, other measurements such as geodetic linking of more distant stations will also be undertaken.

The fourth mission is in the nature of a follow-on to the first three and would probably be implemented in a second-generation Spacelab-borne lidar system. The major objectives of this mission would be to detect and measure a wide range of minor constituents in the stratosphere and troposphere using a retro-reflector sub-satellite at a distance of perhaps 3000 km from the Spacelab so that the grazing altitude is 10-50 km above the earth's surface. A second objective of this mission is the determination of gravitational field harmonics. These measurements will be conducted by suitable tracking and ranging of subsatellites or by a twin probes method.

The lidar facility is to be designed to permit orbiting on many Spacelab missions with different scientific aims and is being achieved by accommodation of a variety of laser stimuli and corresponding detector systems. The basic facility would thus offer both flexibility and growth potential. The major requirements placed on the system include: A telescope in the 1.0-m-dia. class responsive to wavelengths over the range of 0.2 to 10.6 μm, diffraction limited at 10.6 μm, and compatible with a field of view over the range of 10^{-3} to 10^{-6} radians; Laser support sub-systems capable of accommodating dye, Nd-Yag, ruby and gas lasers with input powers up to 2.0 kW; and detector support sub-systems which can accommodate a variety of detector packages of up to 50 kg and provide standard detector/telescope interfaces.

For space-borne lidar applications, the ESA studies have shown that a Cassegrain (Dall-Kirkham) configuration for the telescope is most attractive because of the relatively low number of ancillary optical surfaces, low sensitivity to thermal distortions, easier integration of experimental packages, and because the center of gravity can be close to the mounting axis. The primary mirror may be either lightened Zerodur (50% lightening factor) or of U.L.E. construction with an f number of 2 and a surface tolerance compatible with diffraction limited operation at 10.6 μm. The secondary mirror would be driven along the optical axis to compensate for in-flight thermal defocusing. For the telescope structure three options have been considered: an Invar tube shell with aluminum rings; an aluminum tube shell with Invar secondary mirror metering rods; and a carbon fiber reinforced plastic shell. The choice of structure will be made in the final design study. Thermal design includes a completely insulated concept using multilayer insulation. Aperture doors are employed to minimize contamination by particles when not in operation.

The transmitting system consists basically of a laser and the appropriate transmitting optics. To cover the total wavelength range it is necessary to use two transmission optical systems. The first is a confocal mirror system providing wavelength coverage from 0.2 to 1.06 μm, while the second is a lens system providing coverage in the IR range of 1.06 to 10.6 μm. The optical diameter is about 300 mm. The basic laser support facility consists of a canister unit (with optical window and connectors), an optical platform, an alignment device, a thermal control subsystem, a laser management and control system, and safety engineering components.

The Phase B design stage for the Spacelab lidar system is currently underway at ESA and will provide subsystem designs, system specifications, and cost proposals for a facility concept designed to meet the agreed set of mission models and scientific objectives. Whether or not the system becomes a fully approved ESA program is still uncertain at this writing. (Robert W. Rostron)

NEWS & NOTES

THE NOBEL PRESENTATIONS

The media have already reported on the 1978 Nobel Laureates. Just listing their names and disciplines would be redundant. What is not reported on too widely, except in Sweden, is an account of the actual ceremonies and banquet. From about 3 pm on in Stockholm on 10 December—the anniversary of the death of Alfred Nobel—ladies in resplendent evening gowns and gentlemen in white tie and tails begin their peregrinations to the Concert House from various points of the city. There, promptly at 4:30 pm, the "solemn festival" of the Nobel Foundation begins. Accompanied by trumpet fanfare, King Carl Gustav and Queen Silvia, accompanied by other members of the Royal Family and the Laureates, take their seats on the platform. Then, before each of the recipients is awarded the Prize, a musical selection is offered by the Stockholm Philharmonic Orchestra that correlates with the ethnicity or nationality of the recipient. For example, the selection before the presentation to Isaac B. Singer for literature was the Intermezzo from "Journey to America" by Hilding Rosenberg and the Overture to "Of Thee I Sing" by George Gershwin was played before the presentation of the Prize in Economic Sciences to Herbert A. Simon. The Overture to "Russlan and Ludmilla" by Michail Glinka preceded the presentation of the Prize in Physics to Peter L. Kapitza. On the stage festooned with flowers, after a speech by a member of the Swedish Academy of Sciences highlighting the contributions of the recipient, the King makes the presentation. As is traditional, the speech in each case is given in Swedish, but English translations were readily available on entering the auditorium.

At the end of the presentation ceremonies, the Concert House audience filed out into buses waiting to take them to the banquet at the City Hall. There, approximately 1200 guests found their seats in the beautifully decorated Blue Room. Once again to trumpet fanfare, the King and Queen of Sweden, members of the Royal Family, and the Laureates and their families paraded down the magnificent stairway to their appointed seats at the main table located in the center of the room. There, with great efficiency, the guests were served lobster parisienne, roast duck au calvados, various champagnes, white and red wines. A march down the same stairway by individuals holding large trays filled with ice cream and petits fours was followed by coffee service and liqueurs. During the banquet there was a musical program, selections again representing the different backgrounds of the recipients. There was also singing by the Stockholm Choral Society. At the end of the banquet dinner, each of the Laureates gave a very short speech that was quite pertinent to the occasion. There was also an address to the Laureates by the President of the student body of the University of Stockholm, which was then answered by Laureate Daniel Nathans. All this was followed by ballroom dancing in the Gold Room of the City Hall.

At the risk of repetition for the reader, we list again, in the order of presentation, the recipients and brief citations: Physics: Professor Peter L. Kapitza (USSR) for his basic inventions and discoveries in the area of low-temperature physics; Dr. Arno A. Penzias (US) and Dr. Robert W. Wilson (US) for their discovery of cosmic microwave background radiation; Chemistry: Dr. Peter Mitchell (UK) for his contribution to the understanding of biological energy transfer through the formulation of the chemiosmotic theory; Physiology or Medicine: Professor Werner Arber (Switzerland), Professor Daniel Nathans (US) and Professor Hamilton O. Smith (US) for the discovery of restriction enzymes and their application to problems of molecular genetics; Literature: Isaac Bashevis Singer (US) for his impassioned narrative art, which, with roots in a Polish-Jewish cultural tradition, brings universal human conditions to life; Economic Sciences: Professor Herbert A. Simon (US) for his pioneering research into the decision-making process within economic organizations. (Herbert Solomon)

EEC "RESEARCH"

Recent issues of *ESN* have included articles on various R&D topics supported by the European Community, e.g., Rostron "The European Joint Research Centre—ISPRA Establishment" *ESN* 32-2:44, and Bernstein "Materials Problems at the Joint Research Centre" *ESN* 32-11:375.

In this connection, it is pertinent to refer readers to a recent publication by Gunter Schuster, Director General for Research Science & Education of the Commission of the European Communities Brussels, entitled "European Community Policy in the Field of Science & Technology" which appeared in *Endeavour* New Series 2 (1), 1978.

Schuster identifies the function of the Community S&T policy as threefold:

"1. As a forward-looking sectoral policy, it should seek to progress towards more integration. It is to be hoped that joint projects and programmes will provide an impetus towards greater cooperation between governments, research centres, universities, and industry as well as reducing national research conducted in isolation.

"2. By mobilizing Community potential and by coordination efforts and objectives, the efficiency of European research should be increased. The growing economic and political ties and mutual dependence of Member States call for a new approach to joint research policy. In certain cases the individual Member States are no longer able to deal with problems alone: for example, in the area of energy research.

"3. Finally, it should think ahead for the whole of the European Community and identify and analyze problem areas in which bottlenecks or potential hazards may arise. It should open up new options and define and initiate research and development programmes to produce the results necessary for the future of the Community."

He notes as a "breakthrough" the final approval in January 1974 by the European Community's Council of Ministers of the development by the Commission of a Community S&T policy as opening up new prospects for an overall policy. Prior to this time the Community's research activities had been limited to the fields of atomic energy (EURATOM) and coal & steel (CECA).

Outlining objectives, activities and criteria for Community research, he proceeds to identify the forms of program available to the EEC for its research activity. First, there is Community Research carried out by the Joint Research Centre: Ispra, Italy (Multidisciplinary Research Centre); Geel, Belgium (Central Bureau for Nuclear Measurements); Karlsruhe, FRG (Transuranium Institute); and Petten, the Netherlands (High-temperature Reactor and High-temperature Materials). Secondly, Research under contract conducted by laboratories in the member countries and usually funded on a 50/50 basis between the EEC and the nation. The third form is Research programmed and coordinated at the Community level but financed and carried under the responsibility of the individual nations.

Presenting the ongoing program in some detail, Schuster also discusses difficulties associated with the establishment of an EEC S&T policy, the role of the Community's advisory groups [CERD (European R&D Committee) and CREST (S&T Research Committee)], and longer term priorities. Current funding of the JRC's Community Research is approximately shared equally between nuclear and non-nuclear topics.

Of particular note are statements that "The research action programmes of the European Community are essentially orientated (sic) toward specific objectives and tasks (applied research). Links with pure research are established through cooperation with the European Science Foundation,..." The selection of objectives and tasks is discussed in some depth. (A.W. Pryce)

ONRL NEWS

In late December and early January we welcomed aboard four new Liaison Scientists. Dr. Wayne V. Burt, Professor of Oceanography and Associate Dean of Research, Oregon State Univ., Corvallis; Dr. Irwin M. Freundlich, Professor of Radiology, College of Medicine, Univ. of Arizona, Tucson; Dr. Richard S. Hughes from the Naval Surface Weapons Center, China Lake, CA, who will be covering Lasers and Optical Physics; and Dr. Robert Machol, Professor of Systems, Graduate School of Management, Northwestern Univ., Evanston, IL, who will report on Operations Research. We hope that they will enjoy their tour of duty with ONRL.

THE QUEEN'S NEW YEAR HONOURS LIST

Not many professors in science and technology were named in the 1979 New Year Honours, the preponderance going

to local workers and people in entertainment and sports. Of the six Life Peers, however, two are heads of universities and one lately in NATO: Sir Brian Hilton Flowers, Rector, Imperial College of Science and Technology, Univ. of London; Adml of the Fleet Sir Peter John Hill-Norton RN, Former Chief of Defence Staff and lately Chairman, Military Committee of NATO; and Sir Walter Laing Macdonald Perry, Vice-Chancellor, The Open University. Named Knight Bachelor (KB) were Alastair Robert Currie, Professor of Pathology, Univ. of Edinburgh; Kenneth Mather, Professor of Genetics, Univ. of Birmingham; William Drummond Macdonald Paton, Professor of Pharmacology, Univ. of Oxford; and John Nicholas Walton, Professor of Neurology and Dean of Medicine, Univ. of Newcastle upon Tyne. In the Civil List of the Order of the British Empire, named Commander (CBE) were Prof. A. Ashmore, Director of the Science Research Council's Daresbury Laboratory; H. Cartwright, Director of the Atomic Energy Establishment, Winfrith; and D. Robinson, Chairman of the Social Science Research Council.

PERSONAL

Richard Maynard Case, Reader in Physiology in the Department of Physiology, Univ. of Newcastle upon Tyne, has been promoted to the Chair of Physiology at the Univ. of Manchester from 1 October 1979, in succession to the late Prof. J.N. Mills.

Mr. Alan Douglas Martin, Personal Reader at the Univ. of Durham, has been promoted to a Personal Chair of Physics.

Peter Stanley, Reader in Mechanical Engineering at the Univ. of Nottingham, has been appointed to a Chair of Mechanical Engineering at the Univ. of Manchester from 1 January 1979 in succession to Prof. Jack Diamond.

Mr. R.W. Whorlow, Senior Lecturer in the Univ. of Surrey's Department of Physics has received the first annual award of the British Society of Rheology, in recognition of his outstanding services to the Society.

OBITUARY

Prof. Alexander John Haddow, CMG, FRS, FRSE, Administrative Dean, Faculty of Medicine, and Professor of Administrative Medicine, Univ. of Glasgow, died 27 December 1978 at the age of 65. His basic training in zoology and medicine led to his appointment as a Medical Research Council junior research Fellow in tropical medicine, culminating in his appointment as entomologist to the Yellow Fever Research Institute in Entebbe, Uganda in 1942. He spent 23 years in East Africa where he became an international authority on virus diseases and their vectors. From 1950 to 1965 he was associated with the East African Virus Research Institute, becoming its Director in 1953. In 1965, he returned to Glasgow first as a Senior Lecturer in Epidemiology, than as Director of the Cancer Registration Bureau of the West of Scotland Hospital Region. In 1970 he was appointed Administrative Dean of the Faculty of Medicine, which was combined with a Chair of Administrative Medicine the next year. The Royal Society of Tropical Medicine and Hygiene awarded him its Chalmers gold medal, and he was elected a Fellow of the Royal Society in 1972. He was made a Companion of St. Michael and St. George (CMG) in 1959.

ONRL REPORTS

C-8-78 EUROPEAN UNDERSEA BIOMEDICAL SOCIETY 4TH ANNUAL SCIENTIFIC MEETING by R. Goad

The 4th Annual Scientific Meeting of the European Undersea Biomedical Society was held in Luxembourg on the 12th and 13th of October 1978. This report summarizes the meeting which was concerned with the Medical Aspects of Diving Accidents, and reviews the 20 papers that were given. Presentations were divided into topics relating to one of the four following areas: 1) Unconsciousness of the Diver in the Water, 2) Diagnosis of Decompression Illnesses, 3) Treatment of Decompression Illnesses, and 4) Coincidental Injury or Illness While at Raised Environmental Pressure.

C-12-78 PROGRESS IN CARDIOLOGY by J.C. LaRoque

An international conference of cardiologists gathered to present data and discuss the present status of thinking in four major areas of cardiology. In valvular heart disease, there are numerous problems related to presence of a valve in the body. Mortality curves are highly favorable, however, when compared with the natural history of unoperated valve disease. Porcine heterografts are the wave of the future. The echocardiogram has substantially advanced diagnosis in this area, but it has many limitations which are still being discovered. Congenital heart disease patients are in many cases surviving into adult ages, presenting numerous new problems in management. Though anatomy may be corrected, physiology is not completely corrected. In coronary artery disease the classic question persists: whether thrombosis precedes or follows myocardial infarction. Only 55% of a recent post-mortem series showed thrombosis, implying some other physiologic cause may underlie at least 45% of infarctions. Coronary spasm may occur in 100% of patients with unstable angina. Large clinical trials to limit infarct size are being begun in humans, following the demonstration that this is feasible in dogs, and that precordial mapping is a reliable measure of infarct size in humans. Electrophysiologic techniques have dramatically increased our understanding of rhythm and conduction disturbances. The mechanism of producing and sustaining an arrhythmia can be worked out exactly in many patients with supra-ventricular tachycardia (SVT), ventricular tachycardia (VT), and Wolff-Parkinson-White (WPW) syndrome. Medical management of arrhythmias, however, still escapes a completely rational approach, in spite of numerous new drugs available. Electrophysiologic precision has also increased the opportunities for surgical treatment: VT and SVT with concealed bypass tracts may now be sometimes cured surgically, as well as the WPW syndrome. Congestive cardiomyopathy has been discovered to be associated with high titres of coxsackie virus. Anti-viral therapy may be of the future. Obstructive cardiomyopathy has been shown to have an abnormal but characteristic appearance on heart muscle biopsy. Sudden death remains the most important problem in this group, and high risk families have been identified.

R-9-78 NATIONAL HEALTH SERVICE AND MILITARY MEDICINE IN GREAT BRITAIN by P.F.D. Van Peenen

This report describes similarities and differences between US and British military medicine, with emphasis on preventive medicine. British National Health Service has apparently had remarkably little effect on the mission, organization, and practice of military medicine in the United Kingdom. The major problem for the British military medical services is identical to that for the US: recruitment and retention of physicians.

R-10-78 SOME ELECTRICAL AND ELECTRONICS ENGINEERING ACTIVITIES IN THE USSR by T.G. Berlincourt

This report covers visits made to scientific and technical institutes in the USSR and to the Popov Society Congress during 12-28 May 1978. Institutes visited were the Krenkel Central Radio Club (Moscow), Institute of Radioengineering and Electronics of the Academy of Sciences (USSR), A.A. Baikov Institute of Metallurgy (Moscow), Institute of the Problems of Transfer of Information (Moscow), All-union Electrotechnical Communications Institute by Correspondence (Moscow), Television Center (Moscow), TV Tower, Moscow State University, Ulyanov (Lenin) Electrotechnical Institute (Leningrad), and the Institute of Cybernetics (Kiev).

R-11-78 FLAT PANEL DISPLAY TECHNOLOGY IN EUROPE by D.C. Rummler, J. Silva, A. Nedoluha, and H. Whitted

This report is the result of a survey of Flat Panel Display technologies in early 1978. Countries visited included the United Kingdom, France, and FRG. Selected industrial and governmental research establishments were surveyed for developments in emissive (gas discharge, light emitting diode, electroluminescence) and subtractive (liquid crystal; electrophoretic, electrochromics) display technologies. Significant new applications of these flat panel technologies are also identified.

R-12-78 EUROPEAN DREDGING—A REVIEW OF THE STATE OF THE ART by J.F. Hoffman

The state-of-the-art of dredging in Europe is described. The details are on a three-month on-site investigation in the countries of Belgium, the UK, France, Germany, the Netherlands, and Scotland. Information was obtained during conferences involving more than 40 persons. Visited were two dredging firms, one manufacturer of dredging equipment, three universities, six laboratories concerned with the hydraulics and/or sedimentation in harbors, eight port authorities, and three miscellaneous federal agencies. New dredging technology—modifications to old dredging technology as well as dredging practices in selected European ports is discussed. The facilities and capabilities of the hydraulic laboratories visited are described.